Appendix D

Operable Unit 10-04 Ecological Risk Assessment Approach and Methodology

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Operable Unit 10-04 Ecological Risk Assessment Approach and Methodology

Appendix D is a series of appendices and attachments containing supporting information to the Waste Area Groups (WAGs) and Idaho National Engineering and Environmental Laboratory OU 10-04 ecological risk assessments (ERAs). This information was either previously unpublished or unsummarized and is presented here to ensure agencies and stakeholders are equipped with the data to make an informed decision regarding WAG ERA results and Operable Unit (OU) 10-04 ERA data gaps.

Appendix D is presented in four parts: Appendix D1, "OU 10-04 Ecological Risk Assessment Approach and Methodology," discusses the phased approach used to perform ecological risk assessments at the INEEL and the methodology that will be used for the OU 10-04 ERA. Appendix D1 includes the following eight attachments:

1. Attachment 1, "Refining Preliminary Contaminants of Ecological Concern"
2. Attachment 2, "OU 10-04 Exposure Pathway Analysis and Receptor Identification"
3. Attachment 3, "OU 10-04 ERA Endpoint Development"
4. Attachment 4, "OU 10-04 Summary of Field Activities for 1997 Ecological Sampling"
    a. Attachment 4A, "Soil Profiles"
    b. Attachment 4B, "Daily Field Activities"
5. Attachment 5, "WAG Biological Field Surveys"
6. Attachment 6, "Preliminary Summary of FY-97 Ecological Sampling Analytical Results"
7. Attachment 7, "Example of Evaluation and Dose Reconstruction of Environmental Science and Research Foundation data"
8. Attachment 8, "INEEL Wildlife Spatial Data Analysis"
9. Attachment 9, "1997 OU 10-04 Ecological Sampling Data."

Appendix D2, "EBSL Calculations and Parameter Input Values," documents the calculations and parameter input values used to calculate ecological based screening levels (EBSLs) and presents the EBSLs for both radionuclide and nonradionuclide contaminants at the INEEL. Appendix D3, "WAG ERA Exposure and Parameter Input Values," documents the models and input values used to model exposure for the WAG ERA. Appendix D3 includes the following three attachments:

1. Attachment 1, "Average Decay Energy Tables"
2. Attachment 2, "Bioaccumulation Factors"

3. Attachment 3, "Plant Uptake Factors"

    a. Attachment 3A, "Plant Uptake Factors at the INEEL"

    b. Attachment 3B, "Summary of Plant Uptake Factors for Cs-137, Sr-90, and Tc-99."

Appendix D4, "Toxicity Reference Value Development" documents the approach used to develop toxicity reference values for contaminants identified at the Idaho National Engineering and Environmental Laboratory. This Appendix also documents the toxicity reference values used for both the EBSLs and WAG ERA calculations. Appendix D4 includes the following four attachments:

1. Attachment 1, "Contaminant of Potential Concern Toxicity and Fate and Transport Information"

2. Attachment 2, "Toxicity Reference Values for Mammalian and Avian Functional Groups"

    a. Attachment 2A, "Contaminants of Potential Concern"

3. Attachment 3, "Toxicity"

4. Attachment 4, "Fate and Transport."

Appendix DI

OU 10-04 Ecological Risk Assessment Approach and Methodology

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FIGURES

Appendix D1

OU 10-04 Ecological Risk Assessment Approach and Methodology

D1-1. ERA APPROACH AT THE INEEL

In December 1991, for purposes of assessment and remediation, the Idaho National Engineering and Environmental Laboratory (INEEL) hazardous waste sites were systematically combined into more manageable waste areas through the Federal Facility Agreement and Consent Order (FFA/CO) between the Environmental Protection Agency (EPA) Region 10, State of Idaho, and Department of Energy Idaho Operations Office (DOE-ID). The FFA/CO divides the INEEL into 10 individual waste area groups (WAGs) to facilitate remedial investigations and feasibility studies (RI/FSs). WAGs 1 through 9 generally correspond to INEEL operational facilities (see Figure 1-1 in the Work Plan for WAGs 6 and 10 OU 10-04 Comprehensive RI/FS, hereafter referred to as the Work Plan), while WAG 10 encompasses concerns associated with the Snake River Plain Aquifer and those surface and subsurface areas not included in the bounds of the facility-specific WAGs (DOE-ID 1991). Overall, the INEEL site encompasses a land area of approximately 227,840 ha (569,600 acres) with approximately 2% (4,560 ha [11,400 acres]) covered by 659 buildings and 2,000 support structures (WAGs 1 through 9) (DOE-ID 1994a). WAGs are spatially distributed across the Site and separated by distances as small as 3 km (2 mi) and as great as 48 km (38 mi). There are currently 437 identified sites, with approximately 160 radionuclides and 100 organics and metals identified as contaminants.

D1-1.1 Phased Approach

To address these circumstances, a phased approach to ERA depicted in Figure D1-1 has been implemented at the INEEL. The phased approach allows a systematic method to address multiple sites at each WAG while attempting to address larger issues at the OU 10-04 level.

D1-1.1.1 Phase 1

Phase 1 is either a data gap analysis or a screening level ERA, which is a "preassessment" performed at the WAG level. At this phase:

- Sites identified by the FFA/CO (as well as other subsequently identified potential release sites) at each WAG are eliminated from the assessment, providing that no source of contamination or pathway to ecological receptors exists
- The initial contaminant list to be addressed in subsequent assessments is reduced
- Data gaps and detection limit concerns for ecological receptors are evaluated.

INEEL Phased ERA Approach (1995)

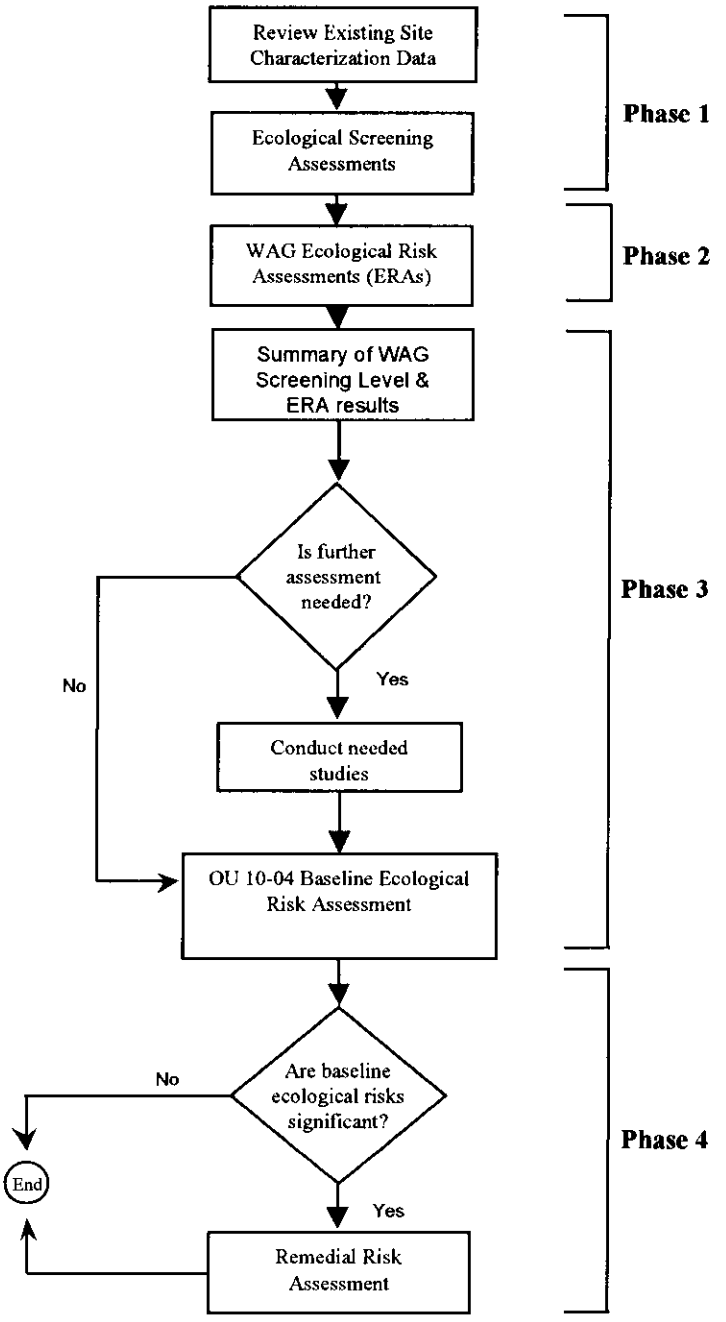

Figure D1-1. Phased approach to ecological risk assessment at the INEEL.

The approach for producing screening level ERAs is presented in the *Guidance Manual for Conducting Screening Level ERAs at the INEL* (VanHorn et al. 1995). This guidance generally parallels the existing EPA guidance (EPA 1992a; EPA 1994; EPA 1995) and was developed to direct the performance of consistent and reproducible ERAs for each of the INEEL WAGs. The exposure modeling, input parameters, default values, and assumptions used in this level of the assessment are documented in Appendix D2.

D1-1.1.2 Phase 2

Phase 2 is the performance of a WAG ERA. The WAG ERA uses the preliminary screening results to assess risks to ecological receptors at the WAG level by comparing these data to values available in the literature. During Phase 2:

- Sites/contaminants identified in Phase 1 are first eliminated by screening against ecologically based screening levels (EBSLs) and background values
- Sites/contaminants are then eliminated based on exposure modeling and dose calculations
- Risk assessment results are reviewed, summarized, and interpreted at the WAG level.

The finalized exposure modeling, input parameters, default values, and assumptions used for this level of assessment are documented in Appendix D3. Appendix D3 contains much of the same information presented in Appendix D2. However, several major differences include: a) the equation parameter defaults, b) the number of receptors analyzed, and c) the use of water ingestion parameters. Duplicate information has been retained to more clearly differentiate between EBSLs developed for screening (SLERA) and exposure calculations applied in WAG-level ERAs.

D1-1.1.3 Phase 3

Phase 3, is the OU 10-04 baseline ERA. At this level the results of the Phase 1 and 2 assessments performed for each WAG are compiled (including WAG 6 and 10 sites). The sites/contaminants remaining after the Phase II WAG ERAs (or Phase 1 if that was all that was available) are identified and used to direct the assessment. This information identifies the data needed to allow evaluation of risks to INEEL-wide ecological resources. A more detailed discussion of the methodology used to perform the Phase 3 assessment is presented in Section D1-2.

D1-1.1.4 Phase 4

Phase 4 of the INEEL approach will include the OU 10-04 Record of Decision (ROD) and the RD/RA for OU 10-04 or for individual WAGs. Long-term monitoring and 5-year reviews for ERA can be added to this flow chart if necessary.

D1-2. OU 10-04 BASELINE ERA

D1-2.1 Introduction

The OU 10-04 baseline ERA is the third phase of the INEEL ERA approach (Figure D1-1). The phased approach at the INEEL is designed to use the results of the WAG ERAs as the primary input to

the problem formulation step of the OU 10-04 ERA. The WAG ERA information is compiled and evaluated with the results of the other existing data and 1997 field sampling. The results will be used to select key receptors, pathways, and COPCs, and to verify foodweb models for the OU 10-04 ERA. The operable unit system established by the FFA/CO framework and a tiered approach similar to the human health Track 1 and 2 assessments have allowed progression to the performance of a large-scale ERA (over 890 square miles). This is considered an efficient and ecologically valid approach to identify actual or potential adverse effects to INEEL ecological receptors as a result of contaminant exposure.

D1-2.2 Objectives

The specific objectives of the OU 10-04 ERA are to: (EPA 1989)

- Define the nature and extent of contamination with respect to ecological receptors on an INEEL-wide scale
- Determine the actual or potential effects of contaminants on protected wildlife species, habitats, or special environments
- Document actual or potential adverse ecological effects of contaminants as part of the OU 10-04 RI
- Provide information for developing OU 10-04 remediation criteria
- Evaluate baseline information to define direction of subsequent monitoring for ecological concerns at the INEEL.

D1-2.3 Spatial and Temporal Scale Assumptions

Spatial and temporal scale need to be adequately defined to allow an accurate determination of the extent of receptor exposure. The following sections present the assumptions made concerning both spatial and temporal scale for the OU 10-04 ERA.

D1-2.3.1 Spatial Scale

As discussed in Appendix C2, Subsection C2-5.2, the OU 10-04 ERA will encompass only the area within INEEL boundaries. No regional issues (regional being the large geographic area that has natural boundaries important to ecological concepts) beyond the INEEL boundary will be addressed, unless evidence of off-Site contamination is found. If risk to INEEL ecological resources were shown, interpretation of that risk in terms of potential impact to regional resources would require off-Site data for comparison. For example, if a significant proportion of an INEEL population is shown to be at risk and that population represents a significant portion of the entire regional population, the ecological importance is elevated and may affect risk management decisions.

D1-2.3.1.1 Terrestrial. The OU 10-04 ERA will evaluate terrestrial ecological resources within the boundaries of the INEEL. Spatial areas of contamination representing potential exposure to ecological receptors across the INEEL (assessment areas) will be defined primarily by human health sampling data, soils, sludge and air monitoring (see Appendix C2, Subsection C2-4.2). Risk, if shown, will be

interpreted at a population level using spatial distribution of species/habitat associations (see Appendix C2, Subsection C2-4.1) within the assessment areas and INEEL-wide.

D1-2.3.1.2 Surface Water. Contaminant characterization for major INEEL watercourses, including the Big Lost River and Birch Creek drainages, has not been performed and will not be quantitatively assessed in the OU 10-04. It is not anticipated these areas will be contaminated. Limited sampling by the ESRF will be done to support this assumption. Evaluation of INEEL aquatic receptors was limited to those associated with WAG facility sewage disposal and industrial waste ponds. The home range for aquatic receptors was assumed to be restricted to the area of individual ponds. The WAG ERA results will be summarized in the OU 10-04 ERA.

D1-2.3.1.3 Ground Water. No pathway from ground water to ecological receptors exists on the INEEL and, therefore, ground water will not be quantitatively evaluated in the OU 10-04 ERA.

D1-2.3.2 Temporal Scale

Current conditions will be evaluated in the OU 10-04 ERA. No future scenarios will be included in the assessment. Duration of receptor exposures are currently reflected by TRV, SUF, and ED exposure model input values, and may be refined for the OU 10-04 ERA exposure models to more accurately reflect temporal exposure patterns (see Appendix C2, Subsection C2-5.1.3).

D1-3. OVERVIEW OF EPA ERA GUIDANCE FOR SUPERFUND

The INEEL approach incorporates the major components of the eight-step ERA process for the Superfund EPA ERA framework (Figure D1-2). The eight-step process will be presented here to provide a framework for presenting and compiling the effort performed for the OU 10-04 ERA. Each section will describe the EPA ERA guidance, WAG ERA activities which have been performed, and activities for completion of the OU 10-04 ERA.

D1-3.1 Problem Formulation Activities for Screening (Step 1)

Problem formulation during the screening activities discussed in Step 1 of the ERA process (EPA 1997) includes the following activities:

1. Environmental setting and contaminants known or suspected to exist at the site
2. Contaminant fate and transport mechanisms that might exist at the site
3. The mechanism of ecotoxicity associated with contaminants and likely categories of receptors that could be affected.

These tasks were performed as part of the Phase 1 and 2 ERA efforts and are documented in the individual WAG Work Plans and Comprehensive RI/BRAs, and in VanHorn et al. (1995). At the Phase 3 ERA level this effort will be also be performed to some extent for the OU 10-04 ERA (based on the information compiled from the WAG ERAs).

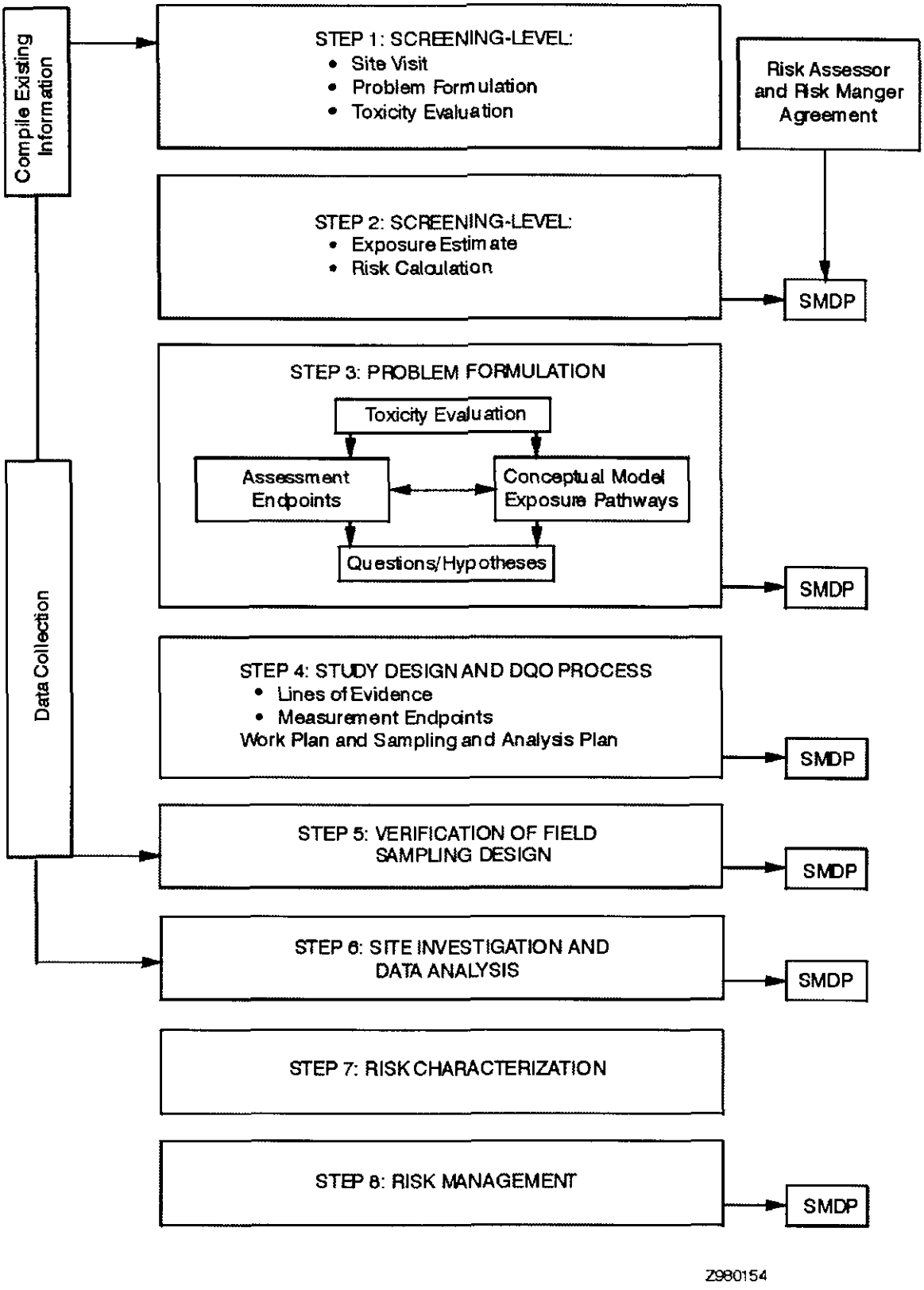

Figure D1-2. Eight-step EPA process for the performing an ERA under Superfund (EPA 1997).

D1-3.2 Screening-Level Exposure Estimate and Risk Calculation (Step 2)

This step includes estimating exposure levels and screening for ecological risk as the last two phases of the screening-level ERA (EPA 1997). It includes developing exposure estimates using conservative assumptions for input parameters. The risk calculation is solely based on the hazard quotient approach and results in a scientific/management decision point (SMDP).

At this phase, the WAG ERAs (Phase 2) are considered preliminary screening activities for the OU 10-04 ERA. The WAG SLERAs and ERAs are documented in the individual WAG Workplans and Comprehensive RI/BRAs. The parameters, exposure models, TRVs and EBSLs used in these assessments are presented in Appendix D2, D3, and D4.).

D1-3.3 Baseline Problem Formulation (Step 3)

"Problem formulation includes a preliminary characterization of exposure and effects and examination of scientific data and data needs, policy and regulatory issues, and site-specific factors to define the feasibility, scope, and objectives for the ecological risk assessment" (EPA 1992a).

The activities performed in the problem formulation are highly interactive and interrelated. The problem formulation directs the level of detail and information that will be needed to complete the assessment and ultimately results in a conceptual site model that describes how a given stressor might affect the ecological components in the environment.

The problem formulation at Step 3 of the ERA process includes the following activities:

1. "Refining preliminary contaminants of ecological concern
2. Further characterizing ecological effects of contaminants
3. Reviewing and refining information on contaminant fate and transport, complete exposure pathways, and ecosystems potentially at risk
4. Selecting assessment endpoints
5. Developing a conceptual model with working hypotheses or questions that the site investigation will address" (EPA 1997).

Many of the tasks discussed in Appendix C2, "OU 10-04 Ecological Data Gap Analysis Report" are related to these activities and will provide the information needed to perform the OU 10-04 ERA.

D1-3.3.1 Refining Preliminary Contaminants of Ecological Concern

Each WAG ERA identified contaminants of concern at the WAG sites using the modeling and parameters as discussed in Appendix D3. The results of the WAG ERAs will be combined and interpreted to support the OU 10-04 problem formulation. The OU 10-04 COPCs will be identified from the WAG ERA's results (including WAG 6 and 10 sites). This initial list of COPCs will be summarized,

analyzed, and refined to develop the COPCs for OU 10-04 ERA as discussed in Attachment D1-1. This task is also discussed in Appendix C2, Subsection C2-4.2.

D1-3.3.2 Further Characterizing Ecological Effects of Contaminants

The initial literature search performed to develop TRVs for the WAG ERAs is adequate for ERA process (Appendix D4). After the OU 10-04 COPC list has been prioritized, it may be desirable to perform sensitivity studies to evaluate the TRVs used in this assessment. It may be appropriate to develop TRVs using other acceptable approaches for use in OU 10-04 ERA. Continued TRV development, maintenance, and evaluation was identified as a potential data gap in Appendix C2, Subsection C2-4.4.

D1-3.3.3 Contaminant Fate and Transport, Complete Exposure Pathways and Ecosystems Potentially at Risk

Preliminary evaluations of contaminant fate and transport, identification of ecosystems potentially at risk, and complete exposure pathways were conducted in the WAG ERA during Phase 2 of the INEEL ERA process. In this step, the contaminant fate and transport will be reevaluated in the OU 10-04 ERA. The exposure pathways and ecosystems associated with endpoints that were retained during the WAG ERAs will also be evaluated in more detail.

D1-3.3.3.1 Contaminant Fate and Transport. Contaminant fate and transport modeling provides information on how a specific contaminant will or could be transported or transformed in the environment physically, chemically, and biologically. The results of this modeling identify the exposure pathways that might lead to significant ecological effects (EPA 1997).

After COPCs for the OU 10-04 ERA are identified as discussed in Subsection D1-3.3.2 above and Attachment D1-1, then fate and transport for each contaminant needs to be reevaluated to more appropriately model possible concentrations of the contaminant in the media. This task was identified as a data gap in Appendix C2, Subsection C2-5.4.

Several biological processes also affect contaminant fate and transport in the environment. To a limited extent both the ESRF data and 1997 field sampling supports the refinement of the literature values used in the INEEL WAG ERAs. The analysis of this information, as discussed in Appendix C2, Subsections C2-4.2 and C2-4.3, can be used to further refine existing data with site-specific data for use in the OU 10-04 ERA.

D1-3.3.3.2 Complete Exposure Pathways. "The potentially complete exposure pathways identified in Steps 1 and 2 are described in more detail in Step 3 on the basis of the refined contaminant fate and transport evaluations and evaluation of potential ecological receptors" (EPA 1997). The basic exposure models used for the WAG ERAs will provide the basis for the OU 10-04 ERA.

Pathway and exposure modeling is discussed as a data gap in Appendix C2, Subsection C2-5.1. Inhalation and dermal exposure models as well as updating existing models (using the results of the ESRF data summary and the 1997 field sampling results) are identified specifically in Appendix C2, Subsection C2-5.1. The exposure pathways and aquatic foodweb are discussed in Attachment D1-2.

D1-3.3.3.3 Ecosystem and Species Potentially At Risk. Ecosystem characterization includes defining the assessment area, describing the types and abundance of different flora and fauna species and

their trophic relationships, and describing any abiotic factors that may be important to the assessment (e.g., climate, topography, soil).

The ecosystem at the INEEL should be adequately characterized for risk assessment purposes as well as to provide baseline information for future monitoring and assessment purposes. Existing information will be used as much as possible to support this effort. Attachment D1-3 provides an example (using the results of the WAGs 2 and 3 ERAs) of how the WAG ERA data will be compiled and used to provide an overview of the receptors at risk in the OU 10-04 ERA. This process ultimately supports assessment endpoint selection.

D1-3.3.4 Selection of Assessment Endpoints

The process for development of preliminary 10-04 ERA endpoints is presented in Attachment D1-3.

D1-3.3.5 The Conceptual Site Model

The Conceptual Site Model (CSM) for OU 10-04 will be developed as part of the ERA problem formulation. The preliminary CSM is presented in Figure D1-3.

D1-3.4 Study Design and Data Quality Objective Process (Step 4)

"Step 4 of the ecological risk assessment establishes the measurement endpoints, completing the conceptual model begun in Step 3. Step 4 also establishes the study design and data quality objectives based on statistical considerations for the site assessment that will accompany site-specific studies for the remedial investigation" (EPA 1997). "The field sampling can then be designed to address the risk model parameters that have important effects on the risk estimates (e.g., bioavailability and toxicity of contaminants in the field, contaminant concentrations at exposure points)" (EPA 1997).

Field sampling performed in 1997 was directed at providing information to support the confirmation of the literature-based biotransfer values used for all of the INEEL ERA models, as no ecological field sampling has been performed at WAG level. The results of the 1997 field sampling will be summarized as part of the Work Plan activities identified in Appendix C2, and compared to those literature values previously used. The actual biotransfer factors calculated from the 1997 field data will then be used in the OU 10-04 ERA to assess exposure. The tasks to evaluate the 1997 field sampling data and incorporate the results in the OU 10-04 ERA are discussed in Appendix C2, Subsection C2-2.2.

No additional field sampling is planned. All data gaps identified in Appendix C2 will be filled solely with literature evaluation and sensitivity studies. Data available from the ESRF data can provide input on historic doses to receptors, contaminant concentrations at exposure points, and limited effects. The ESRF has sponsored two site-specific studies, that to a limited extent, evaluated potential adverse effects from contamination present at the INEEL. The task on summarizing this data for the OU 10-04 ERA is discussed in Appendix C2, Subsection C2-4.3.

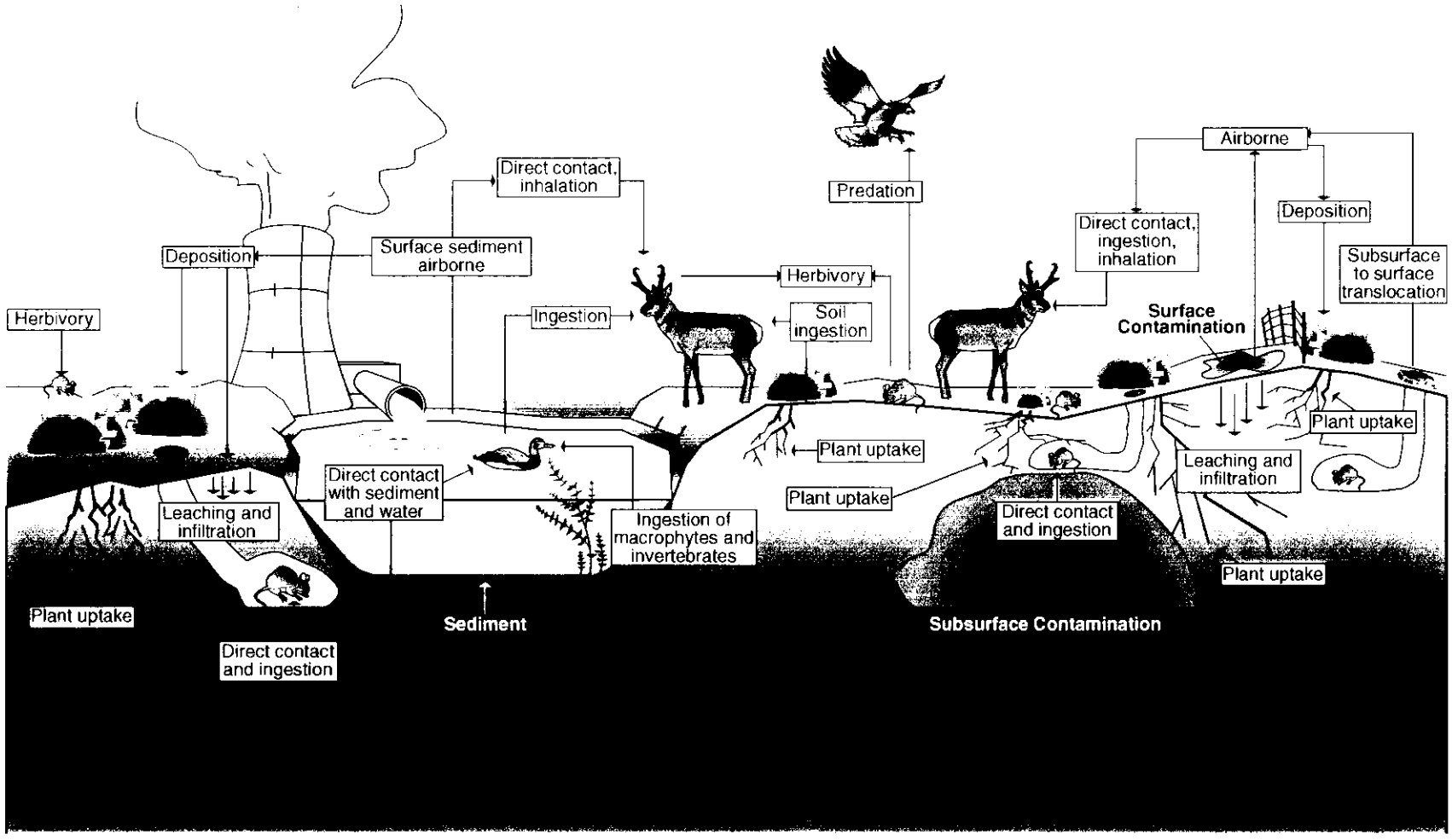

Figure D1-3. OU 10-04 preliminary CSM.

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D1-3.5 Field Verification of Sampling Design (Step 5)

Field verification of the sampling design ensures the field sampling plan is appropriate and implementable at the site. This was performed, during the preparation of the 1997 ecological field sampling. The implementation of the field sampling is documented in Attachment D1-4.

D1-3.6 Site Investigation and Analysis Phase (Step 6)

The site investigation includes all of the field sampling and surveys that are conducted as part of the ERA. Exposure characterization for the OU 10-04 ERA relies heavily on data from the site investigations, surveys, and existing data.

D1-3.6.1 Site Investigation and Surveys

The site investigation section of the OU 10-04 ERA will present and discuss all the field sampling and surveys that were conducted to support the OU 10-04 and WAG ERAs. Several biological surveys were identified as data gaps for the WAG ERAs. These are discussed in detail in Appendix C2, Subsection C2-2.1. The first field survey was conducted in the areas surrounding WAG facilities (not inside WAG boundaries) to assess the use of those areas by threatened or endangered (T/E) or species of concern (i.e., species formerly designated as C2). The second field survey was conducted to evaluate habitat qualities and potential to support INEEL T/E or species of concern at individual sites of concern within WAG facilities. The preliminary results of these WAG field surveys are included in Attachment D1-5.

As discussed in Appendix C2, Subsection C2-2.2, biological samples were collected during the summer of 1997. This effort is referred to as 1997 ecological field sampling and the results will be evaluated. If data that better reflect site specific conditions are found, they will be used to refine the biotic uptake and bioaccumulation factors used in the exposure models. Preliminary exposure models are presented in Appendix D3. If, as a result of data reviews outlined on Table C2-1-1, model input values that better reflect site specific conditions can be developed, models will be refined to incorporate those values. For example, models for some receptors could be made more complex if species diet composition, site specific uptake factors or assimilation rates can be gleaned from reviews of INEEL studies and/or sampling. The initial analysis of the 1997 field sampling analytical results is presented in Attachment D1-6.

D1-3.6.2 Analysis of Ecological Exposures and Effects

The *EPA Framework* (EPA 1992a) states that the analysis phase of the ERA consists of the exposure assessment (characterization of exposure), and the ecological effects analysis. The exposure assessment involves using the information gathered during the problem formulation phase (i.e., contaminant migration and pathways model and stressor characterization) to identify actual or potential exposure routes to ecological receptors, and evaluate the magnitude of exposure to those receptors. In the exposure assessment, exposure concentrations are estimated for each contaminant, for each exposure pathway, and for each receptor. This exposure information is then used to calculate a dose to the receptor. Ecological effects are then determined by comparing the calculated dose to a toxicity reference value derived from the literature. The analysis of exposure and effects is performed interactively, with the analysis of one feeding the analysis of the other (EPA 1997).

In this phase, the site-specific data will replace some of the assumptions made during the Tier I and II assessments. However, the uncertainties associated with the field measurements and with assumptions where site-specific data are not available must be documented (EPA 1997).

D1-3.6.2.1 Characterizing Exposures. Exposure can be expressed as the co-occurrence or contact of the stressor with the ecological components, both in time and space (EPA 1992a from EPA 1997). The ERA exposure assessment is used to determine (qualitatively and quantitatively) the magnitude, frequency, duration, and routes of exposure (i.e., the dose to the receptor). The stressor characterization and the ecosystem characterization performed during the analysis phase of the ERA provide the basis for the exposure analysis and profile (EPA 1992a).

D1-3.6.2.1.1 Stressor Characterization—A stressor is "any physical, chemical, or biological entity that can induce an adverse response" (DOE 1993). Chemical stressors at the INEEL include a variety of organic, inorganic, and radionuclide contaminated media. Physical stressors include the extremes of natural conditions (i.e., winter minimum and summer maximum temperature) and habitat alteration or destruction (i.e., fire). Biological stressors can include introduced species that compete for resources, or overuse of a habitat by an introduced or native species.

For the ERA, identifying the COPCs and developing a concentration for contaminated media (see Subsection D-3.6.2.1.2) has been a major focus. The tiered approach has allowed the sample data collected for human health risk assessment to be assessed at the WAG level (Phases 1 & 2) and compiled for input into the OU 10-04 ERA.

The contaminant fate and transport through the terrestrial and aquatic environments for the contaminants that have been identified in the problem formulation are presented here. During the analysis phase, these contaminants are thoroughly discussed to obtain a complete picture of their movement and activity in the environment. This information, combined with the ecological effects analysis provides an effective picture of the potential movement of the COPC through the ecosystem and allows for an adequate characterization of the risk. "Once the COPCs dominant environmental pathways and fate processes are understood quantitatively, a much clearer picture emerges of the nature of the contamination issue, the behavior of the chemical, and how conditions may be modified to reduce concentration, and hence reduce exposure" (Suter 1993).

In the first two tiers of the INEEL WAG ERA approach, literature values have been used to model the fate and transport and movement through the environment of contaminants. All potential bioaccumulation at WAG sites has been modeled using literature values.

D1-3.6.2.1.2 Define Contaminant Extent—This issue is one of the more critical questions for the OU 10-04 ERA (Phase 3 of the INEEL approach). As discussed in Appendix C2, Subsection C2-4.2 GIS compatible data sets that characterize contaminant extent and concentration for areas outside WAG facility fences are in various stages of completion. These data sets have been constructed primarily from soil sampling data (primarily for radionuclides) collected as part of INEEL human health risk assessment activities. The dimensions of the assessment area for individual WAGs were determined using soil contaminant sampling data and gamma detection data from aerial fly-overs (Jessmore et al. 1994). The maximum distance from WAG contaminant sources for which above-background contaminant levels were detected was determined using the Jessmore et al. (1994) data. An ecological effects buffer of one-half the source to background distance was added to ensure calculation of maximum exposures for species whose home ranges overlap areas of above- and below-background contaminant levels.

Preliminary assessment areas have been established for WAGs 1, 2, 3, 4, 5, 7, 8 and 9 and are shown in Figure D1-4. The location of those sites that will be evaluated during the WAG 6 and 10 sites ERA are only tentatively identified. This includes OU 10-01, OU 10-02, STF-601, STF Gun Range, the WAG 10 ordnance sites, and WAG 6 sites at BORAX and EBR-I. For OU 10-04 ERA, the results of the WAG 6 and 10 sites ERA and other efforts to evaluate contaminant extent will be finalized, and this map will be redrawn.

As discussed in Subsection 2.3.3, contaminant extent for aquatic sites at the INEEL will also be based on existing sample data. Contaminant characterization for major INEEL watercourses, including the Big Lost River and Birch Creek drainages, has not been performed and will not be quantitatively assessed in the OU 10-04 ERA. Evaluation of INEEL aquatic receptors will be limited to those associated with WAG facility sewage disposal and industrial waste ponds. The home range for aquatic receptors will be assumed to be restricted to the area of individual ponds.

Other available data and information will be used to refine and finalize the assessment area and develop ***concentration*** profiles to use in the analysis (see Appendix C2, Subsection C2-4.2). This contaminant concentration data has been documented on WAG sites both inside and outside fenced and controlled (industrial) facility areas. Major data sources include the compilation and evaluation of the ESRF studies, OU 10-06 activities, and 1997 field sampling results.

The ESRF data and the OU 10-06 analysis have documented the movement of radioactive contamination in the environment surrounding the WAGs (such as windblown radionuclide-contaminated soils in the case of OU 10-06 and biotic contamination in the case of the ESRF data). The ESRF studies have evaluated the movement of radioactive contaminants into the biota for over 30 years. This information will be used extensively to support the OU 10-04 ERA. An example of the evaluation and dose reconstruction of the ESRF data for WAGs 2 and 3 is presented in Attachment D1-7. The ESRF monitoring program has also evaluated off-Site areas. This will be discussed as part of the OU 10-04 ERA risk characterization.

The data collected at the WAGs to support the human health risk assessment will be used to determine a contaminant concentration for the assessment areas. It will be necessary to extrapolate a concentration based on WAG site-specific data particularly for metals. Actual sampling values outside of the WAGs are very limited. However, all radionuclide concentration data collected for the OU 10-06 effort, ESRF studies, and metals sampled outside the Idaho Nuclear Technology and Engineering Center (INTEC, formerly ICPP) during the OU 10-04 1997 field sampling will be used for the assessment. Any additional available data and modeling will be used in the OU 10-04 assessment as deemed appropriate. This effort has been identified in Appendix C2. An example of the method use to calculate an exposure point concentration in the assessment area is presented in Attachment D1-7.

D1-3.6.2.1.3 Population data—As discussed in Appendix C2, Subsection C2-4.1 a primary requirement for performing the OU 10-04 assessment is spatial and population data to support GIS interpretation of species distribution and extent of contaminant exposure. Species distribution data sets will be overlaid on contaminant extent and concentration data to assist in the estimation of risk to INEEL populations, as discussed in Appendix D1, Attachment 8.

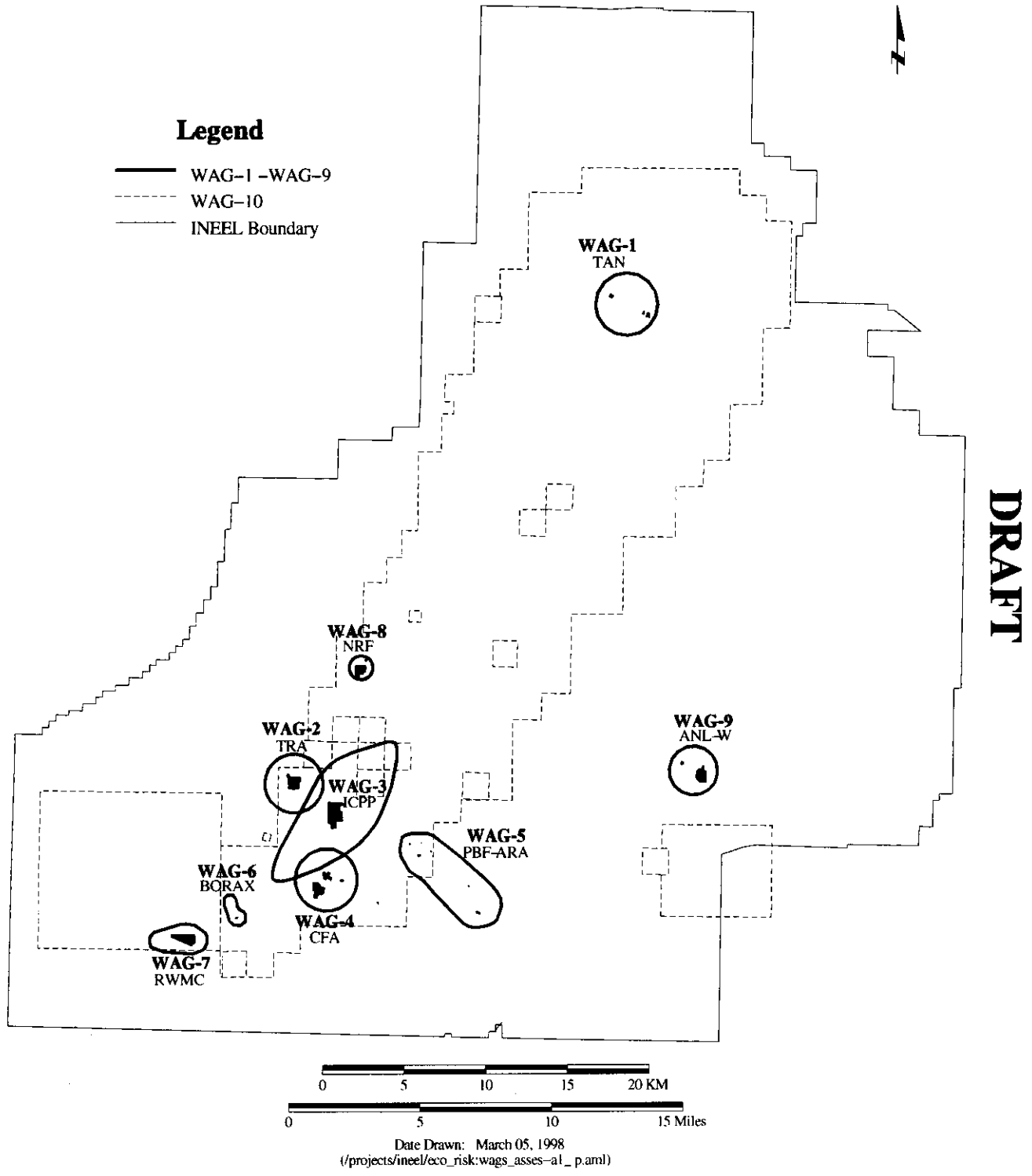

Figure D1-4. Assessment areas for OU 10-04.

D1-3.6.2.2 Characterizing Ecological Effects. Ecological effects in the overall context of ecological risk relates to the adverse (toxic) effects possible to the ecosystem due to exposure to a contaminant. There may also be positive, or no effects as a result of exposure, but these are not generally considered in an assessment. According to the EPA (1989c), a toxicity assessment includes (a) gathering qualitative and quantitative toxicity information for the substance being evaluated, (b) identifying exposure periods for which toxicity values are necessary, (c) determining toxicity values for noncarcinogenic effects, and (d) determining toxicity value for carcinogenic effects. Relevant sources of ecological effects data are summarized in the problem formulation stage of the ERA process. These sources of information include field observation, field tests, laboratory tests, and chemical structure–activity relationships. Information on ecological effects can help focus the assessment on specific stressors and on ecological components that should be evaluated (EPA 1992a). To support this activity, available ecological literature is reviewed and analyzed for information important to developing the conceptual site model.

During Phase 1 and 2 and through Phase 3, the effects assessment (i.e., stressor/response relationship) is reduced to a threshold concentration or dose below which exposures can be assumed to be safe. The development of toxicity reference values (TRVs) is necessary to identify a concentration of each contaminant that may cause a measurable effect in receptors. The INEEL has both radionuclide and nonradionuclide contamination, but these were evaluated differently.

No direct measures of effects will be collected as part of the OU 10-04 ERA. Rather, the relative magnitude of the resulting HQs from the exposure analysis incorporating newly collected data will be used to estimate the likelihood of adverse effects to individuals. There are limited effects studies performed by the ESRF (both in number and usefulness for ERA). These will be summarized and used to support the results of the risk assessment.

D1-3.6.2.2.1 Development of TRVs for Nonradionuclides—Nonradionuclides TRV development was initiated by reviewing the available toxicological literature and relevant databases for each contaminant and functional group members to identify quantified critical exposure levels (QCEs) from the best available study. Studies considering non-lethal endpoints and reporting no-observed-adverse-effects-levels (NOAELs) were selected, if available. Those reflecting reproductive competence are most preferred since such endpoints are considered to best reflect the population-level impacts of greatest concern in ecological risk assessment.

A modification of the Ludwig *et al.* method (1993) based on Lewis (1990) was then applied as discussed in detail in Appendix D4. The method applied various adjustment factors to the QCE, allowing the development of TRVs appropriate to the receptor. For functional grouping, the use of the intertaxon variability (R) was modified as discussed in Appendix D4. Development of TRVs for functional groups during the Tier I and II phases can be expected to increase the conservatism. Generally, an increase in conservatism is the tradeoff associated with the ability to consider all potential receptors in the screening assessment. The studies and QCE values calculated for the COPCs will be used to provide TRVs for receptors as selected for the OU 10-04 ERA.

D1-3.6.2.2.2 Development of TRVs for Radionuclides—Radiological injury is caused by absorption of energy in living tissue from the decay of radionuclides. As in the case of chemical toxicants, the dose of radiation absorbed by any individual organism is a function of its anatomy, physiology, ecology, and behavior. Studies on the effects of radionuclides have shown that the rate of chronic exposure is more important than the total dose (IAEA, 1992). The TRV values for all radionuclides and all animal functional groups was 1 mGy/day, which is the chronic dose below which

there does not appear to be changes observed in terrestrial animal populations (IAEA, 1992). For terrestrial plants, the equivalent dose was 10 mGy/day, and this value was applied as the TRV for terrestrial plants for all radionuclides.

D1-3.6.3 Scientific/Management Decision Point

"An Scientific/Management Decision Point (SMDP) during the site investigation and analysis phase is only needed if alterations to the Work Plan or SAP become necessary" (EPA 1997). No biotic sampling was performed in support of the WAG ERAs and no additional sampling will be performed to support the OU 10-04 ERA effort. Some modifications to the ERA approach proposed in the Work plan are possible. It will be necessary to ensure that the assessment endpoints can be supported by any changes that are proposed.

D1-3.6.4 Summary

Step 6 of the ERA includes the site investigation step and the analysis phase of the ERA. No additional site investigations (other than field surveys) have been proposed to support the OU 10-04 ERA and all site characterization will be performed by evaluating existing information as discussed in Subsection 3.7. "The analysis phase of the ERA consists of the technical evaluation of data on existing and potential exposure and ecological effects and is based on the information collected during Steps 1 through 5 and the site investigations" (EPA 1997). The results of Step 6 are used to characterize ecological risks in Step 7.

D1-3.7 Risk Characterization (Step 7)

The risk characterization, involves the evaluation of the likelihood of adverse effects occurring as a result of exposure to stressors (EPA 1992a). The risk characterization is presented in two major steps: "Risk Estimation" and "Risk Description." The uncertainties identified during all phases of the risk assessment are also summarized at this time. Supporting information in the form of a weight-of-evidence discussion is also presented. The results of the ERA are then discussed with the risk manager.

D1-3.7.1 Risk Estimation

The risk estimation phase of WAG level ERA (Phase 2, see Figure D1-2) compares the exposure and TRVs as well as estimates and summarizes the associated uncertainties (EPA 1992a). Hazard quotients (HQs) are used as semiquantitative indicators of potential contaminant effects to individuals. A HQ is calculated by dividing the dose to the organism from the media of concern by the TRV or benchmark value. A HQ below the target value is interpreted as an indication of the low likelihood of adverse effects to individuals within functional groups/individual species from exposure and maybe extrapolated to the population levels. The HQ method was used to eliminate contaminants from further analysis. However, correct usage of the quotient method is highly dependent on professional judgment, particularly in instances when the quotient approaches the risk target.

The quotient approach will also be useful for the OU 10-04 ERA. Initially, it will be used to identify OU 10-04 COPCs from those HQs that exceed the target value at the WAG ERA. In addition to allowing summation of effects, the approach also enables the determination of relative risk from the suite of contaminants under consideration, and to carry higher risk COPCs through to more detailed risk assessment, while dropping those with low risk. Furthermore, they can be used to prioritize actions (e.g., more sample analyses or site measurements) according to relative risk.

The risk estimation phase of the OU 10-04 ERA will evaluate the extent of exposure to contaminant levels estimated to be over acceptable HQs to the population of selected receptors, T/E species, and species of special concern. The results across the INEEL for multiple contaminants will be integrated to obtain an estimate of the level of effects that will result from the exposure. The uncertainty analysis identifies and, if possible, quantifies the uncertainty in the assessment (EPA 1992a).

Details of this analysis will be discussed briefly in the OU 10-04 Work Plan. The approach will re-evaluate the effects of the contaminant and then ultimately evaluate the extent and magnitude of the contamination as follows:

1. Identify COPC/receptor combinations for which HQs exceed target value (0.1 for radionuclide contaminants and 1.0 for nonradionuclide contaminants).

2. Use toxicity studies from the literature to estimate the relative severity of potential effects to individual and group receptors for which HQs exceed the target value.

3. Use existing data to estimate the INEEL receptor distributions.

4. Use spatial analysis of habitat to estimate the proportion of exposed populations.

5. Estimate the effects for individual populations predicted to be affected.

6. Both individuals and populations are of concern, therefore the same approach will be applied for individuals as well as populations. Biological surveys conducted as part of the FSP will be used to support the spatial analyses for T/E and species of concern.

D1-3.7.2 Risk Description

"A key to risk description is documentation of environmental contamination levels that bound the threshold for adverse effects on the assessment endpoints" (EPA 1997). The risk description also summarizes the risk assessment allowing the risk manager to judge the likelihood and ecological significance of the estimated risk (EPA 1997). The description of risk has two primary elements:

1. Interpretation of ecological significance, which describes the importance of the identified risks to the assessment endpoint

2. Ecological risk summary, which summarizes the results of the risk estimation and evaluates the confidence in the risk estimates through a weight-of-evidence discussion.

The risk summary cannot be reduced to a "yes or no" answer; that is, a contaminated medium is either a potential risk to a given ecological endpoint, or has no or low likelihood of risk. It is important to describe the risk to the risk manager with a weight-of-evidence discussion. "The weight-of-evidence discussion provides the risk manager with insight about the confidence of the conclusions of the risk assessment by presenting the positive and negative aspects of the data, including uncertainties identified throughout the process" (EPA 1992). The following are suggested (EPA 1992) for inclusion in a weight-of-evidence discussion:

- Sufficiency and quality of data—Are data sufficient to support the findings of the assessment? Data validity (e.g., adherence to protocols, having sufficient replications) is an important consideration.

- Corroborative information—Supplementary information relevant to conclusions reached in the assessment.

- Evidence of causality—The degree of correlation between the presence of a stressor and some adverse effect.

The interpretation of ecological significance defines the types and extent of anticipated effects from risk estimates. It is a "critical link" between the estimation of risks and the communication of assessment results (EPA 1992). The interpretation step relies on professional judgment and may emphasize different aspects including "the nature and magnitude of the effects, the spatial and temporal patterns of the effects, and the potential for recovery once a stressor is removed" (EPA 1992).

D1-3.7.2.1 Threshold for Effects on Assessment Endpoints. Key outputs of the risk characterization step are contaminant concentrations in each environmental medium that bound the threshold for estimated adverse ecological effects given the uncertainty inherent in the data and models used (EPA 1997).

Depending on the assessment objectives, all these elements may be used to place the risks into the broader ecological context. This discussion may consider the consequences of the effects on other ecological components that were not specifically addressed in the assessment. For example, an assessment that focuses on the potential of adverse effects on a certain percentage of the population of small mammals will include a discussion of the broader ecological role of small mammals, such as being a food base for raptors and predatory mammals. In this way, the potential effects on the community that depends on small mammals can be brought out in the assessment.

D1-3.7.2.2 Likelihood of Risk. If appropriate, simulation models, which integrate the stressor-response and exposure profiles, can estimate the probability that effects will occur as a result of exposure. This estimation is accomplished by error analysis using Monte Carlo simulation to propagate the uncertainties associated with the model parameters through the model. The product is a probability distribution of outcomes. Most simulation modeling has been directed at population and ecosystem level effects where test data are scarce.

D1-3.7.2.3 Additional Risk Information. Additional risk information that will be used to put the risk estimates in context includes "the degree to which the threshold for contamination is exceeded or is likely to be exceeded in the future," and "the expected half-life (qualitative or quantitative) of contaminants in the environment (e.g., sediments, food chain) and the potential for natural recovery once the sources of contamination are removed" (EPA 1997).

D1-3.7.3 Uncertainty Analysis

The ERA uncertainty analysis identifies and, to the extent possible, quantifies the uncertainty in problem formulation, analysis, and risk characterization (EPA 1992a). The uncertainties from each of these phases of the process are carried through as part of the total uncertainty of the risk assessment. The product of the uncertainty analysis is an evaluation of the impact of the uncertainties on the overall assessment and, when feasible, a description of the ways in which uncertainty could be reduced. The

basic categories include conceptual model uncertainty, natural variation and parameter error, and model error. These will be summarized and discussed in the risk characterization.

D1-3.7.4 Summary

Risk characterization integrates the results of the assessment. "It consists of the risk estimation and risk description, which together provide information to help judge the ecological significance of risk estimates in the absence of remedial activities" (EPA 1997). In order to ensure that the risk characterization allows adequate decision, information regarding the strengths and limitations of the assessment must be identified and described (EPA 1997).

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Appendix D1
Attachment 1

Refining Preliminary Contaminants of Ecological Concern

CONTENTS

TABLES

Appendix D1
Attachment 1

Refining Preliminary Contaminants of Ecological Concern

D1-1-1. COMPILATION OF WAG ECOLOGICAL RISK ASSESSMENT RESULTS

A primary requirement for the OU 10-04 Ecological Risk Assessment (ERA) is to compile and evaluate results from individual WAG ERAs. The WAG level ERAs are the second phase in a three-phase approach in the INEEL ERA process, the third being the OU 10-04 assessment. A detailed discussion of the INEEL phased approach is given in Appendix D-1.

A critical part of the OU 10-04 ERA problem formulation is to perform a WAG level ERA for each INEEL facility and to interpret and combine the results of those assessments to identify the following:

1. Contaminants of potential concern (COPCs) to be assessed for OU 10-04

2. INEEL ecological receptors exposed to those COPCs

3. Source, extent, and distribution of individual COPCs across the INEEL

4. Additional WAG-level gaps in information or data that must be filled prior to conducting the OU 10-04 ERA.

A methodology for compiling the results of each WAG ERA has been developed for the purpose of identifying COPCs and receptors to be evaluated in the OU 10-04 ERA. Three major steps are included:

1. **Summarizing Hazard Quotients (HQs) > 1 for each COPC, across sites within each WAG (average and maximum).** The average HQs will be determined by summing the HQs by contaminant and receptor for all sites within the WAG demonstrating concentrations above ecologically based screening levels (EBSLs) and background levels and dividing by the number of sites. The maximum HQs will be found by comparing the data across each of the sites in a WAG and taking the maximum value for each receptor (individual species or functional group). The maximum HQ represents the highest calculated for that contaminant. Example summaries for average and maximum arsenic HQs for WAGs 1, 2, 3, and 5 are given in Tables D1-1-1 and D1-1-2. A preliminary list of COPCs to be evaluated is given on Table D1-1-3.

2. **Summarizing receptors for which HQ > 1 by contaminant and identifying receptors for which HQs could not be calculated (COPC/receptor combinations across WAGs).** Once summaries have been completed for all WAG ERA results, HQs will be compiled for each COPC/receptor combination for each WAG. An example summary of arsenic HQs for WAGs 2 and 3 is included in Table D1-1-4. This table demonstrates the receptors for which HQs exceed target values for arsenic contamination at WAGs 2 and 3 and those receptors for which HQs could not be calculated because no TRV was available or receptors were not in a pathway for that COPC. Receptors that could not be assessed for a given COPC will be carried through the summary process and evaluated qualitatively in the OU 10-04 ERA.

Table D1-1-1. Average arsenic HQs (preliminary).

Functional Groups	WAG 1	WAG 2	WAG 3	WAG 5
Amphibians (A232)	NC[a]	NC	NC	NC
Avian herbivores (AV121)	4E-02	1E-02	4E-03	4E-03
Avian herbivores (AV122)	4E-01	2E-01	6E-02	5E-02
Avian herbivores (AV132)	NP[b]	1E-06	NP	NP
Avian herbivores (AV142)	NP	5E-07	NP	NP
Avian herbivores (AV143)	NP	1E-06	NP	NP
Trumpeter swan	NP	4E-03	NP	NP
Avian insectivores (AV210)	2E+00	4E-01	2E-01	2E-01
Black tern	1E-01	7E-02	4E-02	1E-02
Avian insectivores (AV210A)	6E+00	1E+00	3E-01	6E-01
Avian insectivores (AV221)	2E+01	4E+00	1E+00	2E+00
Avian insectivores (AV222)	2E+01	4E+00	1E+00	3E+00
Avian insectivores (AV222A)	1E+01	2E+00	8.E-01	2E+00
Avian insectivores (AV232)	NP	5E-07	NP	NP
Avian insectivores (AV233)	NP	4E-07	NP	NP
White-faced ibis	NP	1E-06	NP	NP
Avian insectivores (AV241)	NP	5E-07	NP	NP
Avian insectivores (AV242)	NP	2E-06	NP	NP
Avian carnivores (AV310)	3E-03	7E-04	2E-03	3E-04
Northern goshawk	4E-04	1E-04	4E-03	4E-05
Peregrine falcon	3E-03	7E-04	2E-02	3E-04
Avian carnivores (AV322)	1E-01	3E-02	2E-02	1E-02
Bald eagle	9E-05	3E-05	5E-05	1E-05
Ferruginous hawk	3E-04	1E-04	2E-04	4E-05
Loggerhead shrike	1E-01	3E-02	1E-02	1E-02
Avian carnivores (AV322A)	2E-02	5E-03	3E-03	2E-03
Burrowing owl	2E-02	5E-03	3E-03	2E-03
Avian carnivores (AV333)	NP	1E-06	NP	NP
Avian carnivores (AV342)	NP	2E-06	NP	NP
Avian omnivores (AV422)	1E+00	2E-01	1E-01	1E-01
Avian omnivores (AV432)	NP	1E-06	NP	NP
Avian omnivores (AV433)	NP	2E-06	NP	NP

Table D1-1-1. (continued).

Functional Groups	WAG 1	WAG 2	WAG 3	WAG 5
Avian omnivores (AV442)	NP	7E-06	NP	NP
Mammalian herbivores (M121)	1E-02	3E-03	2E-03	1E-03
Mammalian herbivores (M122)	3E+00	1E+00	4E-01	7E-01
Mammalian herbivores (M122A)	6E+00	1E+00	4E-01	8E-01
Pygmy rabbit	1E+00	2E-01	8E-02	2E-01
Mammalian herbivores (M123)	4E+00	7E-01	3E-01	5E-01
Mammalian insectivores (M210)	6E+00	1E+00	3E-01	4E-01
Mammalian insectivores (M210A)	6E+00	1E+00	3E-01	2E+00
Townsend's western big-eared bat	2E+01	3E+00	8E-01	2E+00
Small-footed myotis	2E+01	5E+00	1E+00	2E+00
Long-eared myotis	2E+01	4E+00	1E+00	2E+00
Mammalian insectivores (M222)	5E+01	1E+01	5E+00	8E+00
Mammalian carnivores (M322)	1E-01	3E-02	2E-02	2E-02
Mammalian omnivores (M422)	2E+01	3E+00	8E-01	2E+00
Mammalian omnivores (M422A)	5E-01	9E-02	8E-02	5E-02
Reptilian insectivores (R222)	NC	NC	NC	NC
Sagebrush lizard	NC	NC	NC	NC
Reptilian carnivores (R322)	NC	NC	NC	NC
Plants	5E+00	1E+00	8E-01	1E+00

a. NC-not calculated, no TRV available.

b. NP-these receptors were not in the pathways analyzed for the WAG sites of concern.

Table D1-1-2. Maximum arsenic HQs (preliminary).

Functional Groups	WAG 1	WAG 2	WAG 3	WAG 5
Amphibians (A232)	NC[a]	NC	NC	NC
Avian herbivores (AV121)	4E-02	6E-02	3E-02	1E-02
Avian herbivores (AV122)	4E-01	9E-01	5E-01	8E-02
Avian herbivores (AV132)	NP[b]	1E-05	NP	NP
Avian herbivores (AV142)	NP	4E-06	NP	NP
Avian herbivores (AV143)	NP	1E-05	NP	NP
Trumpeter swan	NP	2E-02	NP	NP
Avian insectivores (AV210)	2E+00	2E+00	2E+00	6E-01
Black tern	1E-01	4E-01	4E-01	4E-02
Avian insectivores (AV210A)	6E+00	7E+00	2E+00	2E+00
Avian insectivores (AV221)	2E+01	1E+01	4E+00	5E+00
Avian insectivores (AV222)	2E+01	2E+01	3E+00	6E+00
Avian insectivores (AV222A)	1E+01	1E+01	2E+00	4E+00
Avian insectivores (AV232)	NP	4E-06	NP	NP
Avian insectivores (AV233)	NP	3E-06	NP	NP
White-faced ibis	NP	9E-06	NP	NP
Avian insectivores (AV241)	NP	4E-06	NP	NP
Avian insectivores (AV242)	NP	1E-05	NP	NP
Avian carnivores (AV310)	3E-03	4E-03	2E-02	8E-04
Northern goshawk	4E-04	6E-04	4E-02	1E-04
Peregrine falcon	3E-03	4E-03	2E-01	7E-04
Avian carnivores (AV322)	1E-01	2E-01	1E-01	3E-02
Bald eagle	9E-05	2E-04	6E-04	3E-05
Ferruginous hawk	3E-04	6E-04	2E-03	1E-04
Loggerhead shrike	1E-01	2E-01	1E-01	4E-02
Avian carnivores (AV322A)	2E-02	3E-02	3E-02	7E-03
Burrowing owl	2E-02	3E-02	3E-02	7E-03
Avian carnivores (AV333)	NP	9E-06	NP	NP
Avian carnivores (AV342)	NP	1E-05	NP	NP
Avian omnivores (AV422)	1E+00	1E+00	1E+00	3E+00
Avian omnivores (AV432)	NP	1E-05	NP	NP
Avian omnivores (AV433)	NP	2E-05	NP	NP

Table D1-1-2. (continued).

Functional Groups	WAG 1	WAG 2	WAG 3	WAG 5
Avian omnivores (AV442)	NP	6E-05	NP	NP
Mammalian herbivores (M121)	1E-02	2E-02	2E-02	4E-03
Mammalian herbivores (M122)	3E+00	4E+00	8E-01	2E+00
Mammalian herbivores (M122A)	6E+00	5E+00	8E-01	2E+00
Pygmy rabbit	1E+00	1E+00	2E-01	4E-01
Mammalian herbivores (M123)	4E+00	3E+00	5E-01	1E+00
Mammalian insectivores (M210)	6E+00	7E+00	2E+00	1E+00
Mammalian insectivores (M210A)	6E+00	7E+00	2E+00	8E+00
Townsend's western big-eared bat	2E+01	2E+01	5E+00	5E+00
Small-footed myotis	2E+01	3E+01	7E+00	8E+00
Long-eared myotis	2E+01	2E+01	6E+00	7E+00
Mammalian insectivores (M222)	5E+01	4E+01	1E+01	2E+01
Mammalian carnivores (M322)	1E-01	2E-01	2E-01	5E-02
Mammalian omnivores (M422)	2E+01	2E+01	2E+00	3E+00
Mammalian omnivores (M422A)	5E-01	6E-01	9E-01	2E-01
Reptilian insectivores (R222)	NC	NC	NC	NC
Sagebrush lizard	NC	NC	NC	NC
Reptilian carnivores (R322)	NC	NC	NC	NC
Plants	5E+00	4E+00	3E+00	2E+00

a. NC-not calculated, no TRV available.

b. NP-these receptors were not in the pathways analyzed for the WAG sites of concern.

Table D1-1-3. Preliminary WAG summary of contaminants and TRVs.

CAS #	COPC	TRVS			Potentially Present at WAGs
		Mammalian	Avian	Vegetation	
7429-90-5	Aluminum	X	X	X	1,3,9
7446-70-0	Aluminum chloride	X			7
21645-51-2	Aluminum hydroxide	X			7
13473-90-0	Aluminum nitrate	X			7
7784-27-2	Aluminum nitrate nonahydrate				7
10043-01-3	Aluminum sulfate		X		7
7664-41-7	Ammonia	X			7
7440-36-0	Antimony	X		X	1,2,3,4,9
7440-38-2	Arsenic	X	X	X	1,2,3,4,8,9
1332-21-4	Asbestos	X			7
7440-39-3	Barium	X		X	1,2,3,9
7440-41-7	Beryllium	X		X	9
7440-42-8	Boron	X		X	3
7440-43-9	Cadmium	X	X	X	1,2,3,4,7,9
7440-70-2	Calcium				4,5,7,9
7790-86-5	Cerium chloride	X			7
16887-00-6	Chloride	X			9
7440-47-3	Chromium (III)	X	X	X	1,2,3,7,9
7440-47-3	Chromium (VI)	X		X	1,2,3,7,9
7440-48-4	Cobalt	X	X	X	1,9
7440-50-8	Copper	X	X	X	1,2,3,4,7,9
16984-48-8	Fluoride	X	X		1,2,3,7,9
7664-39-3	Hydrofluoric acid	X			7
7439-89-6	Iron			X	1,9
7439-92-1	Lead	X	X	X	1,2,3,4,7,8,9
7439-95-4	Magnesium	X			7,9
7783-40-6	Magnesium fluoride				7
7439-96-5	Manganese	X	X	X	1,7,9
7439-97-6	Mercury (Inorganic)	X	X	X	1,2,3,4,7,9
7439-98-7	Molybdenum	X		X	3
7440-02-0	Nickel	X	X	X	1,3,7,9
14797-55-8	Nitrate	X	X		3,7
7697-37-2	Nitric acid	X			7
1594-56-5	Nitrite				2
7440-09-7	Potassium				1,9
7447-40-7	Potassium chloride	X			7
1310-58-3	Potassium hydroxide	X			7
7757-79-1	Potassium nitrate	X			7

Table D1-1-3. (continued).

CAS #	COPC	TRVS			Potentially Present at WAGs
		Mammalian	Avian	Vegetation	
7778-53-2	Potassium phosphate	X			7
7778-80-5	Potassium sulfate	X			7
7782-49-2	Selenium	X	X	X	1,2,3,9
7440-22-4	Silver	X		X	1,2,3,4,9
7440-23-5	Sodium	X			1,4,9
7647-14-5	Sodium chloride	X			7
1310-73-2	Sodium hydroxide	X			7
7631-99-4	Sodium nitrate	X	X		7
7601-54-9	Sodium phosphate	X			7
7757-82-6	Sodium sulfate				7
7440-24-6	Strontium	X			1,2,3
14808-79-8	Sulfate	X	X		1,7,9
7440-28-0	Thallium	X	X	X	1,2,9
7440-31-5	Tin	X		X	1,2
7440-61-1	Uranium	X	X		3,5,7
7440-62-2	Vanadium	X	X	X	1,9
7440-66-6	Zinc	X	X	X	1,2,9
7440-67-7	Zirconium	X			7
75-35-4	1,1-Dichloroethylene	X			7
71-55-6	1,1,1 Trichloroethane	X			7
76-13-1	1,1,2-Trichloro-1,2,2-Trifluoroethane				7
79-34-5	1,1,2,2-Tetrachloroethane	X			4
120-82-1	1,2,4-Trichlorobenzene	X			4
106-46-7	1,4-Dichlorobenzene				1
78-93-3	2-Butanone	X			4,9
108-41-8	2-Chlorotoluene	X			4
591-78-6	2-Hexanone				1
91-57-6	2-Methylnaphthalene	X			1
88-75-5	2-Nitrophenol				7
67-63-0	2-Propanol	X			7
51207-31-9	2,3,7,8,-Tetrachloro dibenzodioxin	X	X		9
105-67-9	2,4-Dimethylphenol	X			7
94-75-7	2,4-Dichlorophenoxyacetic acid	X			7
121-14-2	2,4-Dinitrotoluene	X			7
106-47-8	4-Chloroaniline	X			2,3
106-44-5	4-Methylphenol	X			7
59-50-7	4-Chloro-3-methylphenol (CMP)	X			7
83-32-9	Acenaphthene	X			1,4,7

Table D1-1-3. (continued).

CAS #	COPC	TRVS			Potentially Present at WAGs
		Mammalian	Avian	Vegetation	
67-64-1	Acetone	X			2,3,4,7
75-05-8	Acetonitrile	X			2
107-13-1	Acrylonitrile	X			2
120-12-7	Anthracene	X			4
71-43-2	Benzene	X			7
8032-32-4	Benzine				7
56-55-3	Benzo(a)anthracene	X			1,4
50-32-8	Benzo(a)pyrene	X			1,3,4
205-99-2	Benzo(b)fluoranthene (BbF)	X			1,2,3,4
207-08-9	Benzo(k)fluoranthene				7
191-24-2	Benzo(g,h,i)perylene				1
71-36-3	Butyl alcohol	X			7
85-68-7	Butylbenzylphthalate (BBP)	X			9
75-15-0	Carbon disulfide	X			5
56-23-5	Carbon tetrachloride	X			7
67-66-3	Chloroform	X			7
74-8-7-3	Chloromethane				1
218-01-9	Chrysene	X			1,2,4
57-12-5	Cyanide	X	X		1,3,7,9
112-31-2	Decanal				3
132-64-9	Dibenzofuran				2
75-71-8	Dichlorodifluoromethane				1
117-81-7	Di-2-ethylhexyl-phthalate (DEHP)	X			1,3
84-66-2	Diethyl phthalate	X			3
131-11-3	Dimethyl phthalate				4
84-74-2	Di-n-butylphthalate	X		X	4
117-84-0	Di-n-octylphthalate	X			4
64-17-5	Ethanol (Ethyl alcohol)	X			7
100-41-4	Ethylbenzene	X			1,4
206-44-0	Fluoranthene	X			4
86-73-7	Fluorene	X			4
50-00-0	Formaldehyde	X			7
302-01-2	Hydrazine	X			7,9
78-59-1	Isophorone				5
193-39-5	Indeno(1,2,3)pyrene				1
7439-97-6	Mercury (Organic)	X	X	X	1,2,3,4,7,9
67-56-1	Methanol (Methyl alcohol)	X			7
108-10-1	Methyl isobutyl ketone	X			7

Table D1-1-3. (continued).

CAS #	COPC	TRVS			Potentially Present at WAGs
		Mammalian	Avian	Vegetation	
75-09-2	Methylene chloride	X			4,7
103-65-1	n-Propylbenzene	X			7
91-20-3	Naphthalene	X			1,4
78-48-8	Orthophosphate				2
11097-69-1	PCBs-Aroclor 1254	X	X	X	1,4
11096-82-5	PCBs-Aroclor 1260	X		X	1
85-01-8	Phenanthrene				1
108-95-2	Phenol	X			7
107-12-0	Propionitrile				1
129-00-0	Pyrene	X			4
143-33-9	Sodium cyanide	X			7
18496-25-8	Sulfide				1,2
7664-93-9	Sulfuric acid	X			4,7
26140-60-3	Terphenyl	X			7
127-18-4	Tetrachloroethylene	X			7
109-99-9	Tetrahydrofuran	X			1
108-88-3	Toluene	X		X	4,7
	Total Petroleum Hydrocarbon				1,4
126-73-8	Tributyl phosphate	X			7
79-01-6	Trichloroethylene (Trichloroethene)	X			4,7
15625-89-5	Trimethylopropane-triester	X			7
108-05-4	Vinyl acetate				1,5
1330-20-7	Xylene	X			1

x = indicates the availability of a TRV.

Table D1-1-4. Example summary of arsenic HQs for WAG 2 and WAG 3 (preliminary).

	Maximum Hazard Quotient		Average Hazard Quotient	
Functional groups	WAG 2	WAG 3	WAG 2	WAG 3
Amphibians (A232)				
Avian herbivores (AV121)	6E-02	3E-02	1E-02	4E-03
Avian herbivores (AV122)	9E-01	5E-01	2.E-01	6E-02
Avian herbivores (AV132)	1E-05		1E-06	
Avian herbivores (AV142)	4E-06		5E-07	
Avian herbivores (AV143)	1E-05		1E-06	
Trumpeter swan	2E-02		4E-03	
Avian insectivores (AV210)	2E+00	2E+00	4E-01	2E-01
Black tern	4E-01	4E-01	7E-02	4E-02
Avian insectivores (AV210A)	7E+00	2E+00	1E+00	3E-01
Avian insectivores (AV221)	1E+01	4E+00	4E+00	1E+00
Avian insectivores (AV222)	2E+01	3E+00	4E+00	1E+00
Avian insectivores (AV222A)	1E+01	2E+00	2E+00	8E-01
Avian insectivores (AV232)	4E-06		5E-07	
Avian insectivores (AV233)	3E-06		4E-07	
White-faced ibis	9E-06		1E-06	
Avian insectivores (AV241)	4E-06		5E-07	
Avian insectivores (AV242)	1E-05		2E-06	
Avian carnivores (AV310)	4E-03	2E-02	7E-04	2E-03
Northern goshawk	6E-04	4E-02	1E-04	4E-03
Peregrine falcon	4E-03	2E-01	7E-04	2E-02
Avian carnivores (AV322)	2E-01	1E-01	3E-02	2E-02
Bald eagle	2E-04	6E-04	3E-05	5E-05
Ferruginous hawk	6E-04	2E-03	1E-04	2E-04
Loggerhead shrike	2E-01	1E-01	3E-02	1E-02
Avian carnivores (AV322A)	3E-02	3E-02	5E-03	3E-03
Burrowing Owl	3E-02	3E-02	5E-03	3E-03
Avian carnivores (AV333)	9E-06		1E-06	
Avian carnivores (AV342)	1E-05		2E-06	
Avian omnivores (AV422)	1E+00	1E+00	2E-01	1E-01
Avian omnivores (AV432)	1E-05		1E-06	

Table D1-1-4. (continued).

Functional groups	Maximum Hazard Quotient		Average Hazard Quotient	
	WAG 2	WAG 3	WAG 2	WAG 3
Avian omnivores (AV433)	2E-05		2E-06	
Avian omnivores (AV442)	6E-05		7E-06	
Mammalian herbivores (M121)	2E-02	2E-02	3E-03	2E-03
Mammalian herbivores (M122)	4E+00	8E-01	1E+00	4E-01
Mammalian herbivores (M122A)	5E+00	8E-01	1E+00	4E-01
Pygmy rabbit	1E+00	2E-01	2E-01	8E-02
Mammalian herbivores (M123)	3E+00	5E-01	7E-01	3E-01
Mammalian insectivores (M210)	7E+00	2E+00	1E+00	3E-01
Mammalian insectivores (M210A)	7E+00	2E+00	1E+00	3E-01
Townsend's western big-eared bat	2E+01	5E+00	3E+00	8E-01
Small-footed myotis	3E+01	7E+00	5E+00	1E+00
Long-eared myotis	2E+01	6E+00	4E+00	1E+00
Mammalian insectivores (M222)	4E+01	1E+01	1E+01	5E+00
Mammalian carnivore (M322)	2E-01	2E-01	3E-02	2E-02
Mammalian omnivores (M422)	2E+01	2E+00	3E+00	8E-01
Mammalian omnivores (M422A)	6E-01	9E-01	9E-02	8E-02
Reptilian insectivores (R222)				
Sagebrush lizard				
Reptilian carnivores (R322)				
Plants	4E+00	3E+00	1E+00	8E-01

HQ > 1 for both WAG 2 and WAG 3

HQ > 1 for only 1 WAG

No TRV data or was not in the pathway for this COPC

3. **Refining and ranking WAG COPCs to produce OU 10-04 COPC list.** The list of COPCs that were not eliminated in Step 1 will be subjected to a ranking/screening procedure to prioritize COPC/receptor combinations for the OU 10-04 assessment. This list of COPCs will be reduced and prioritized based on a modification of the approach used by Oak Ridge National Laboratory (Suter, et al. 1995). This includes evaluating whether a COPC occurs at multiple WAGs or other locations at the INEEL. The higher priority will be given to those contaminants that are present at more than one WAG at the INEEL. Each contaminant will then be assessed for volatility, environmental degradation, persistence, and bioavailability/bioaccumulation. Those COPCs with high volatility, rapid environmental degradation, low persistence, and low bioavailability will be evaluated for elimination from the list. COPCs with low volatility, slow degradation, high persistence, and high potential for bioaccumulation will be evaluated for retention. An example of this process, using WAGs 2 and 3 contaminants, is presented in Table D1-1-5.

Table D1-1-5. Example of the preliminary evaluation and selection of COPCs summarized from the WAG ERAs (from Suter et al. 1996).

Contaminant	WAG	Factors Considered in Evaluation	Retained	References
Organics:				
Acetone	2,3	Highly volatile; low potential for bioaccumulation	NO	ATSDR 1992e
Acrylonitrile	2	Low potential for bioaccumulation	NO	Sax and Lewis 1987
Benzo(a)pyrene	3	Both lipophilic and persistent	YES	Eisler 1987b
Benzo(b)fluoranthene	2,3	Both lipophilic and persistent	YES	Eisler 1987b
4–Chloroaniline	2,3	Highly volatile; low potential for bioaccumulation	NO	Sax and Lewis 1987
Chrysene	2	Both lipophilic and persistent	YES	Eisler 1987b
Cyanide	3	CN has low persistence, rapid environmental and metabolic degradation and does not biomagnify or cycle in biota	NO	Eisler 1991
Decanal	3	May bioaccumulates in biota	YES	Sax and Lewis 1987
Di(2–ethylhexyl)phthalate	3	May bioaccumulate in biota	YES	Sax and Lewis 1987
PCBs	2,3	Lipophilic, persistent, bioaccumulate	YES	Eisler 1986b
Inorganics:				
Aluminum	3	A ubiquitous element; while soluble Al may be toxic, toxicity of insoluble Al is low. Most Al in environment is in relatively insoluble forms and biologically unavailable; may become available under conditions of low pH (< 4.5).	NO	Adriano 1986
Antimony	2,3	Not appreciably taken up by plants; low potential for bioaccumulation but highly toxic	NO	ATSDR 1992a
Arsenic	2,3	Bioaccumulates in biota, present in coal ash	YES	Eisler 1988a
Barium	2,3	Not very mobile in most soils, however may bioaccumulate somewhat	YES	ATSDR 1992b
Boron	3	Bioaccumulates in biota	YES	Eisler 1990a
Cadmium	2,3	Bioaccumulates in biota	YES	Eisler 1985a
Chromium (III)	2,3	Bioaccumulates in biota	YES	Eisler 1986a
Chromium (VI)	2,3	Bioaccumulates in biota	YES	Eisler 1986a
Copper	2,3	Essential nutrient; low potential for bioaccumulation	NO	ATSDR 1990a
Fluoride	2,3	Bioaccumulates in biota	YES	Sax and Lewis 1987
Lead	2,3	Pb may be taken up by plants and transferred to other biota	YES	Eisler 1988b
Mercury	2,3	Bioaccumulates in biota	YES	Eisler 1987a
Molybdenum	3	Bioaccumulates in biota	YES	Eisler 1989b
Nickel	3	May bioaccumulate in biota	YES	ATSDR 1988

Table D1 - 1 - 5. (continued).

Contaminant	WAG	Factors Considered in Evaluation	Retained	References
Nitrate	3	Bioaccumulates in biota	YES	Sax and Lewis 1987
Selenium	2,3	Bioaccumulates in biota, present in coal ash	YES	Eisler 1985b
Silver	2,3	Rare element; low potential for bioaccumulation	YES	ATSDR 1990b
Strontium	2,3	Sr (including radiostrontium) is taken up by plants and accumulates in bones	YES	NAS 1980
Thallium	2	Taken up by plants from soil; bioaccumulates in biota	YES	ATSDR 1992d
Tin	2	While inorganic Sn is generally not bioavailable, organotin compounds may be generated in aquatic systems; organotin compounds bioaccumulate and are more toxic	YES	Eisler 1989a
Total Petroleum Hydrocarbons	3	Retain and evaluate as BTEX and PAHs. Both are lipophilic and persistent.	YES	ATSDR 1993
Zinc	2	Essential nutrient; bioaccumulates in biota	YES	ATSDR 1989
Radionuclides:				
Am-241	2,3	Taken up by both plants and animals	YES	Garton 1981
Cm-244	2	Taken up by both plants and animals	YES	Garton 1981
Co-60	3	May be mobile in soils; may bioaccumulate	YES	ATSDR 1992c
Cs-134	2,3	Accumulates in biota	YES	Eisenbud 1987
Cs-137	2,3	Cs-137 accumulates in biota and may be transferred up food chains	YES	Kalas et al. 1994
Eu-152	3	Accumulates in biota	YES	Eisenbud 1987
Eu-154	3	Accumulates in biota	YES	Eisenbud 1987
Np-237	3	Accumulates in biota	YES	Eisenbud 1987
Pu-238	2,3	Taken up by both plants and animals	YES	Garton 1981
Pu-239/240	2,3	Taken up by both plants and animals	YES	Garton 1981
Sr-90	2,3	Sr (including radiostrontium) is taken up by plants and accumulates in bones	YES	NAS 1980
U-234	3	Bioaccumulation low due to low assimilation efficiency	YES	ATSDR 1990c
U-238	3	Bioaccumulation low due to low assimilation efficiency	YES	ATSDR 1990c

D1-1-2. REFERENCE

Suter G. W., II et al., 1996, Approach and Strategy for Performing Ecological Risk Assessments for the U.S. Department of Energy's Oak Ridge Reservation: 1996 Revision, Martin Marietta Energy Systems, Inc., ES/ER/TM-33/RL

Appendix D1
Attachment 2

OU 10-04 Exposure Pathway Analysis and Receptor Identification

CONTENTS

FIGURES

TABLES

Appendix D1
Attachment 2

OU 10-04 Exposure Pathway Analysis and Receptor Identification

D1-2-1. OU 10-04 PATHWAYS AND EXPOSURE ROUTES

The exposure pathways to be evaluated in the OU 10-04 Ecological Risk Assessment (ERA) have been combined to develop an INEEL site model conceptualizing major contaminant pathways and associated routes of exposure (Figure D1-2-1). The model incorporates exposure routes for surface soil, subsurface soil, and surface water pathways and major release mechanisms including wind, biotic uptake, surface runoff, and subsurface to surface transport. The exposure routes that will be characterized as part of the OU 10-04 ERA include:

- Soil or sediment exposure or both (dietary ingestion)
- Dietary ingestion (ingestion of forage and prey species)
- Surface water exposure (dietary ingestion)
- Air inhalation and dermal exposure (COPC and pathway specific).

A preliminary food web analysis has been performed to characterize the major dietary linkages for INEEL biota.

D1-2-1.1 INEEL Terrestrial Food Web

Soil, subsurface soil, surface water, and sediment pathways will be assessed to address all pertinent transfer mechanisms, pathways, and exposure routes to characterize contaminant movement through the INEEL terrestrial food chain including:

- Soil or sediment → all trophic levels through ingestion
- Soil or sediment → vegetation → primary consumers → secondary consumers → tertiary consumers
- Water → all trophic levels through drinking.

Dietary information from the literature was incorporated to construct a terrestrial food web (Figure D1-2-2). Only major dietary linkages between functional groups are represented in this preliminary model, and species in bold represent those for which dietary information specific to the INEEL or similar areas exists. Functional groups have been combined to allow simplified graphical depiction, and only the most common residents and threatened or endangered (T/E) or species of concern are presented as group representatives. A more detailed evaluation of dietary data will be included in the problem formulation for the OU 10-04 ERA.

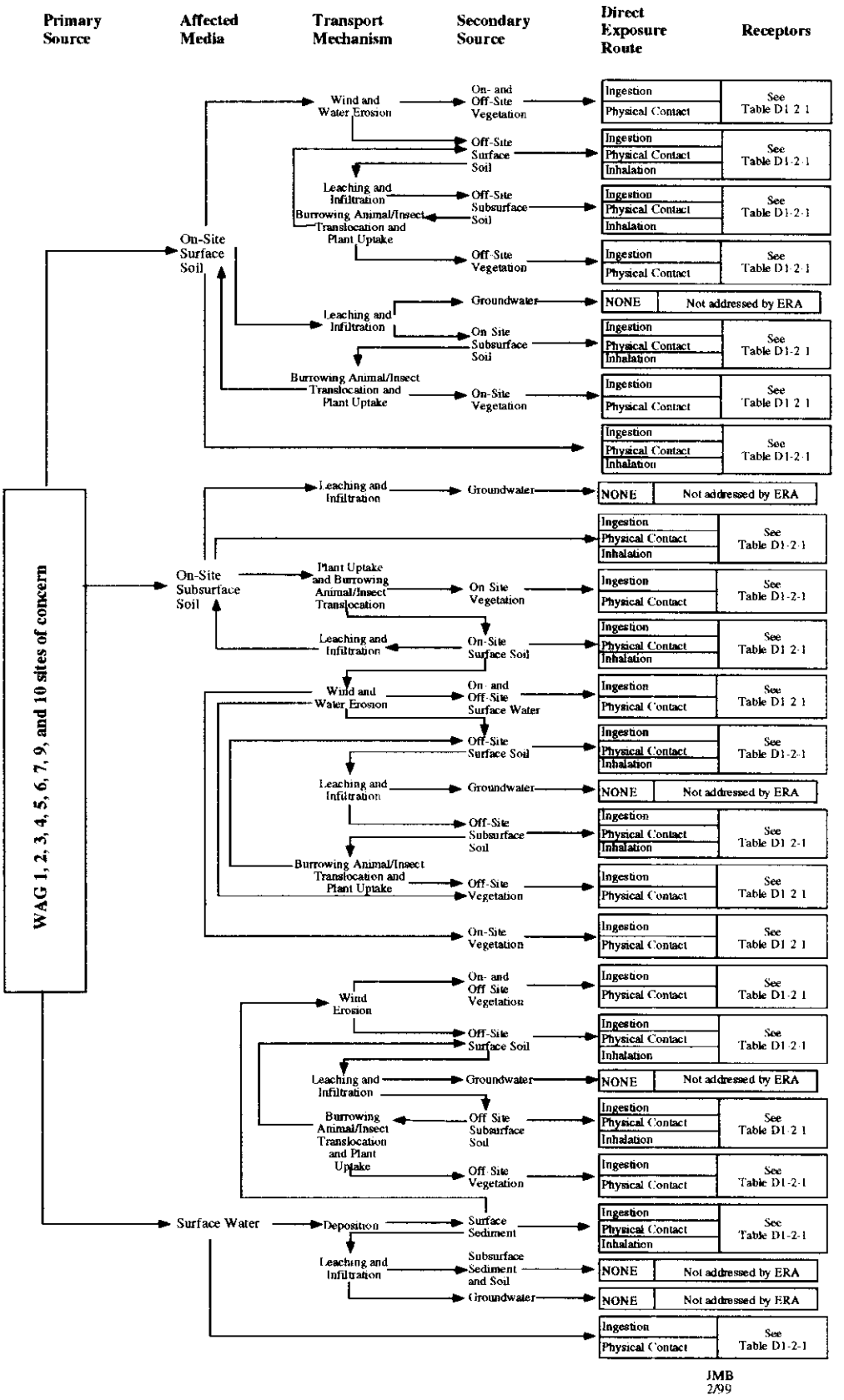

Figure D1-2-1. Draft OU 10-04 pathways and exposure routes.

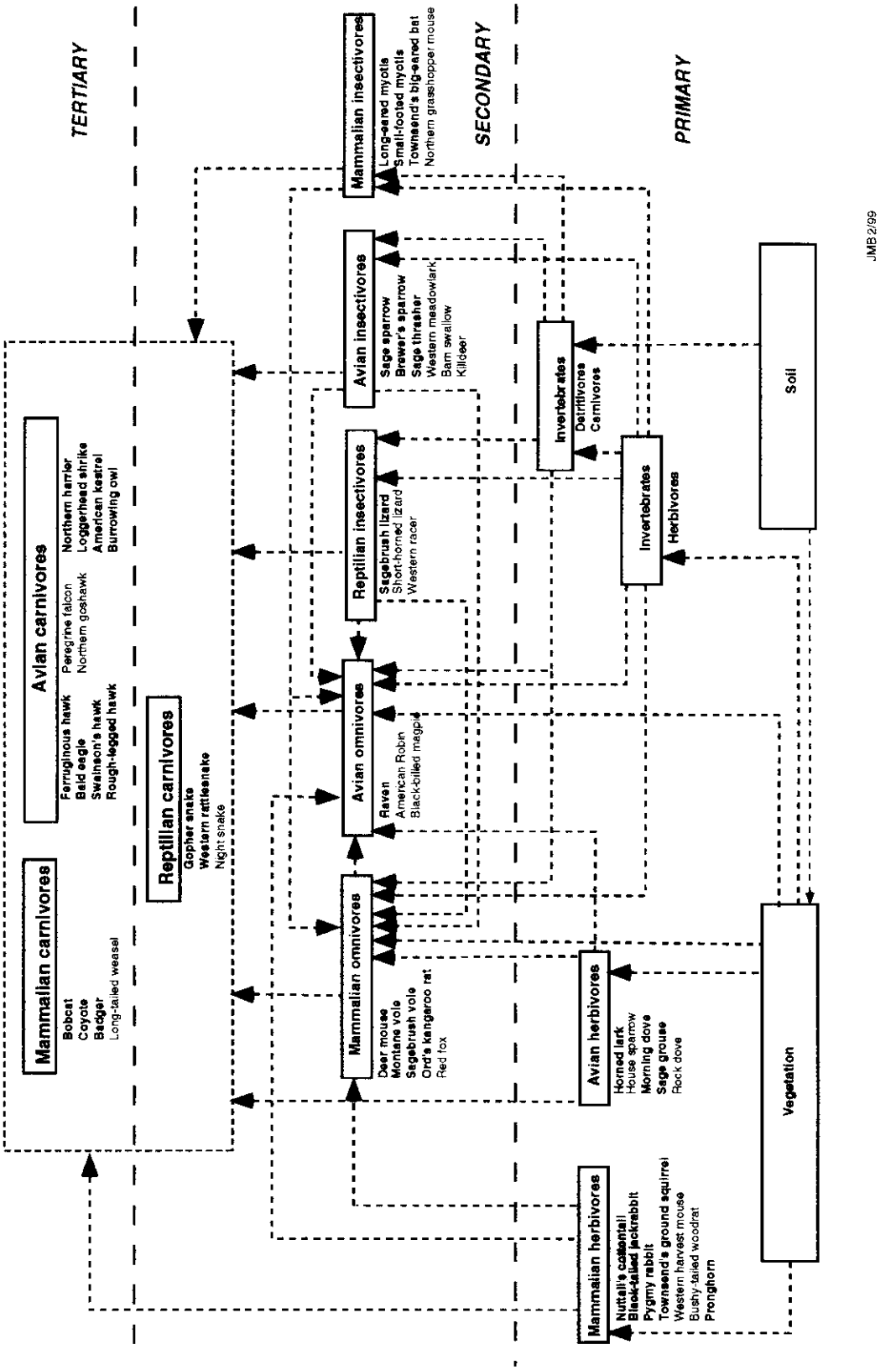

Figure D1-2-2. Draft INEEL terrestrial food web.

D1-2-1.2 INEEL Aquatic Food Web

A draft INEEL aquatic food web representing the linkages between ecological receptors and facility waste disposal and industrial ponds is presented in Figure D1-2-3. Linkages represented in this model are not intended to reflect food web dynamics for INEEL natural-surface water systems. Surface water and sediment pathways will be assessed to address all pertinent transfer mechanisms, pathways, and exposure routes required to adequately characterize contaminant movement through the INEEL aquatic food chain including:

- Water and sediment → vegetation and benthic invertebrates → air- and water-feeding secondary consumers → tertiary consumers

Water ingestion through drinking is accounted for at all trophic levels through allometric equations implemented in the exposure modeling. Trophic linkages were developed primarily from INEEL literature. Only major dietary linkages between functional groups are represented in this preliminary model. Functional groups have been combined to allow simplified graphical depiction, and common species have been included in the example as group representatives. A more detailed evaluation of dietary data for aquatic species will be included in the problem formulation for the OU 10-04 ERA.

D1-2-2. EXPOSURE ANALYSIS AND RECEPTOR IDENTIFICATION

A summary of risk to receptors associated with individual exposure routes will be based on the finalized OU 10-04 COPC list (Appendix D1, Attachment 1). An example receptor identification and pathway analysis for OU 10-04 is given in Table D1-2-1, and an example receptor exposure analysis for three COPCs (arsenic, lead, and chromium) using results from WAG 2 and WAG 3 ERAs is given in Tables D1-2-2 through D1-2-5. Receptors for which risk is shown at the WAG level will be carried to the OU 10-04 ERA.

The receptor summary will be used to identify potential contaminant exposures for key ecological receptors (functional groups, individual species or taxa, or other representatives for biotic resources) considered to be critical components representing OU 10-04 assessment endpoints. The relationship between these ecological components and OU 10-04 assessment endpoints is discussed in Appendix D1 Attachment 3.

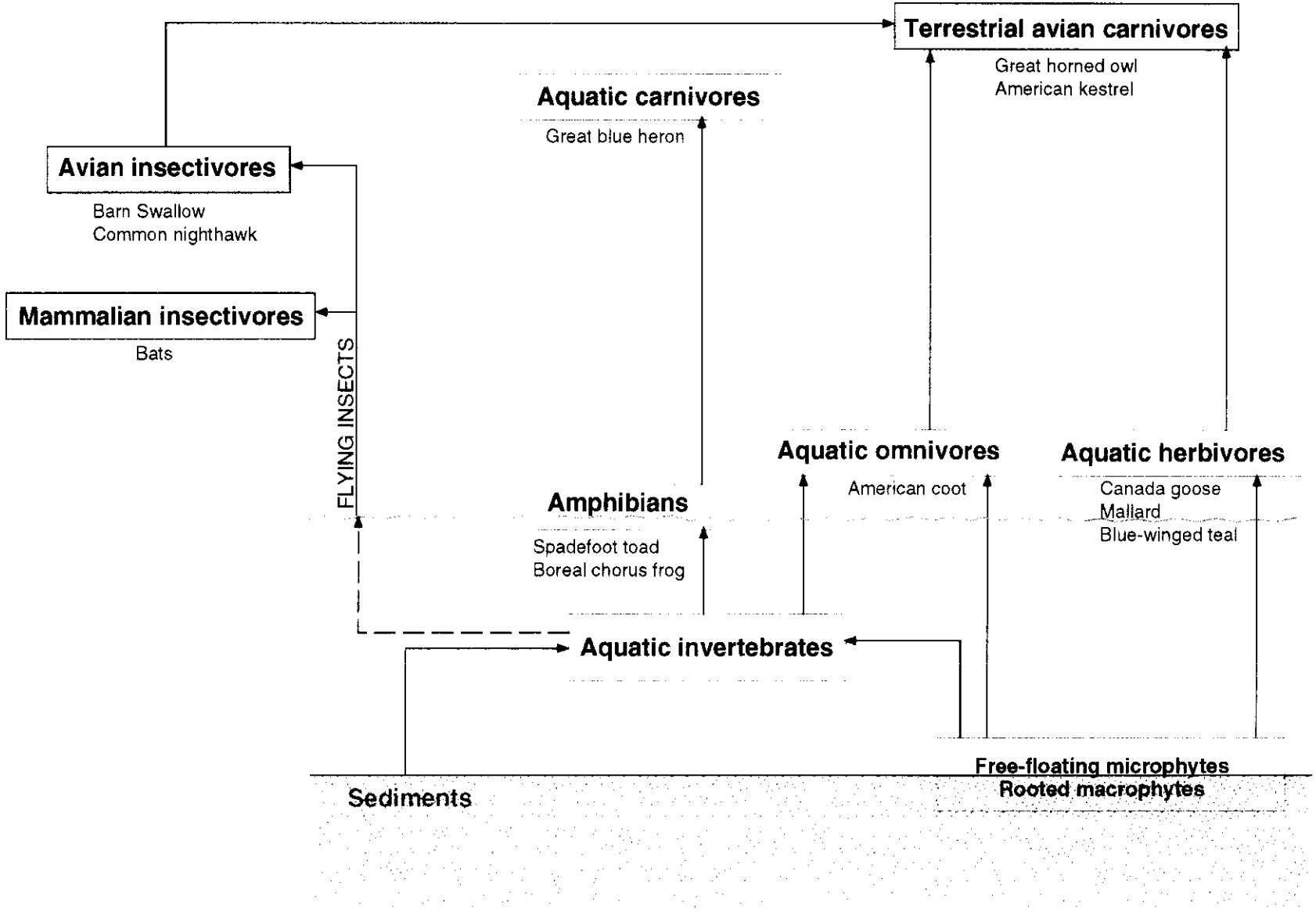

Figure D1-2-3. Draft Aquatic food web for WAG industrial waste and sewage treatment ponds.

Table D1-2-1. Example of WAG ERA pathway and receptor exposure analysis for OU 10-04.

	EXPOSURE MEDIA and ROUTES																		10-04 ENDPOINTS ADDRESSED									
	surface soil			subsurface soil			vegetation			surface water			sediments			prey													
RECEPTOR	Ingestion	physical contact	Inalation	Ingestion	physical contact	Inalation	Ingestion	physical contact		Ingestion	physical contact		Ingestion	physical contact	Inalation	Invertebrates	Mammals	Birds	WAG #	Plant community structre and habitat	Plant species of concern	Forage production	Soil productivity and structure	Integrity of food/prey base	INEEL game species populations	INEEL native aquatic populations	INEEL native wildlife populations	INEEL species of concern	Food chain linkagea	Aesthetic values/unique populations
Amphibians (A232)										x	x		x	x		x			1,2,3,9					x		x		x	x
Spadefoot toad										x	x		x	x		x			7										
Avian herbivores (AV122)	x	x					x												10								x		x	
Sagegrouse	x	x					x	x		x									10						x		x		x	x
Mourning dove	x	x					x	x		x									10					x	x		x		x	
Avian herbivores (AV143) - Trumpeter swan							x			x	x		x	x					1,2,3,9							x		x	
Avian insectivores (AV210, 210A)										x			x			x			1,2,3,7,9								x		x	
Black tern										x			x	x		x			1,2,3,7,9							x		x		
Barn swallow										x			x	x		x			1,2,3,7,9								x		x	
Avian insectivores (AV222)	x	x						x								x			10								x		x	
Sage sparrow	x	x						x								x			10								x			
Meadowlark	x	x						x		x						x			10					x			x		x	
Killdeer	x	x								x						x			each wag										x	
Avian insectivores (AV232)								x		x	x		x	x		x			1,2,3,7,9										x	
Avian insectivores (AV233) - White-faced ibis										x	x		x			x			1,2,3,9									x	x	
Avian carnivores (AV310) -	x									x							x	x	10								x	x	x	
Northern goshawk	x																x	x	10									x		
Peregrine falcon	x																x		10									x		
American kestrel	x																x	x	each wag								x		x	
Northern harrier	x																x		10								x		x	
Avian carnivores (AV322) -	x									x							x		10								x	x	x	
Bald eagle	x																x		10									x		x
Ferruginous hawk	x																x		10									x	x	
Loggerhead shrike	x																x	x	10									x	x	x
Avian carnivores (AV322A) - Burrowing owl	x	x	x	x	x	x										x	x		10									x		x
Avian omnivores (AV422)							x									x	x	x	10									x	x	
Avian omnivores (AV442)							x									x			1,2,3,9						x				x	
Mammalian herbivores (M122)	x	x	x				x			x									10								x	x	x	
Blacktailed jackrabbit	x	x	x				x			x									10					x					x	
Mule deer	x	x	x				x			x									10						x		x			
Pronghorn	x	x	x				x			x									10						x		x			
Mammalian herbivores (M122A)	x	x	x	x	x	x	x												10					x			x		x	

Table D1-2-1. (continued).

	EXPOSURE MEDIA and ROUTES																			10-04 ENDPOINTS ADDRESSED										
	surface soil			subsurface soil			vegetation			surface water			sediments			prey			WAG #											
RECEPTOR	Ingestion	physical contact	Inalation	Ingestion	physical contact	Inalation	Ingestion	physical contact		Ingestion	physical contact		Ingestion	physical contact	Inalation	invertebrates	Mammals	Birds		Plant community structre and habitat	Plant species of concern	Forage production	Soil productivity and structure	Integrity of food/prey base	INEEL game species populations	INEEL native aquatic populations	INEEL native wildlife populations	INEEL species of concern	Food chain linkages	Aesthetic values/unique populations
Pygmy rabbit	x	x	x	x	x	x	x												10					x				x		x
Nuttall's cottontail	x	x	x	x	x	x	x			x									10					x			x		x	
Townsend's groundsquirrel	x	x	x	x	x	x													10					x			x		x	
Ord's kangaroo rat	x	x	x	x	x	x													10					x			x		x	
Mammalian insectivores (M210A)	x									x						x			10, 2,3,7,9								x		x	
Townsend's western big-eared bat	x									x						x			10									x		x
Small-footed myotis	x									x						x			10									x		x
[a]Long-eared myotis										x						x			10									x		x
Mammalian insectivores (M222) - Merriam's shre	x	x	x							x			x	x	x	x			1,9,8									x		
Mammalian carnivore (M322) - coyote or bobcat	x	x	x							x							x		10								x		x	
Mammalian omnivores (M422)	x	x	x	x	x	x	x									x			10					x			x		x	
Reptilian insectivores (R222) - Sagebrush lizard																x			10									x		
Reptilian carnivores (R322)																	x		10								x			x
Aquatic invertebrates										x			x						1,2,3,7,9					x		x				
Terrestrial invertebrates	x	x	x																					x			x			
Phytophagous							x																	x						
Saprophagous	x																						x	x						
Entomophagous																x								x						
Pollinators							x													x	x	x		x						
Plants																			10	x	x	x	x	x					x	x
a. Receptor represents a major link in either the terrestrial or aquatic food web.																														

Table D1-2-2. Example summary of risk to INEEL plant receptors based on average HQ for WAGs 2 and 3 sites of concern.

WAG 10 Assessment Endpoint[b]	RISK	WAG ERA endpoint	Number of COPCs for which Avg. HQ is exceeded					
			WAG 1	WAG 2	WAG 3	WAG 4	WAG 5	WAG 6
INEEL plant community structure and habitat value	Y	Plants		2/3[a]	2/3			
Wildlife and livestock forage production	Y	Plants		2/3	2/3			
Plant species of concern: Lemhi milkvetch Plains milkvetch Wing-seed evening primrose Spreading gilia Ute's ladies tresses	Y	Plants (all)		2/3	2/3			
Soil productivity and structure	U	NONE		NA	NA			

a. Number of COPCs from which the average HQ is exceeded, i.e., 2 out of 3.

b. See Appendix D1 Attachment 3 for discussion of OU 10-04 assessment endpoints.

Y = HQ ≥ 1 for at least 1 COPC.

N = HQ < 1 for all COPCs.

U = Unknown.

NA = Data (primarily TRVs) are not available to assess these endpoints.

--- =Endpoint was not in pathway for COPC.

Table D1-2-3. Example summary of risk to INEEL wildlife receptors based on average HQ for WAGs 2 and 3 sites of concern.

WAG 10 Assessment Endpoint[b]	RISK	WAG ERA endpoint	WAG 1	WAG 2	WAG 3	WAG 4	WAG 5	WAG 6
INEEL terrestrial wildlife community structure, T/E and species of concern:								
Avian herbivores	Y	Functional group (AV121)		1/3[a]	0/3			
	Y	Functional group (AV122)		2/3	1/3			
Mammalian herbivores	N	Functional group (M121)		0/3	0/3			
Pygmy rabbit	Y	Functional group (M122A)		2/3	1/3			
	Y	Pygmy rabbit		1/3	1/3			
	Y	Functional group (M122)		2/3	2/3			
Avian insectivores	Y	Functional group (AV210, AV210A)		2/3	0/3			
Black tern	N	Black tern		0/3	0/3			
	Y	Functional group (AV222)		3/3	2/3			
Mammalian insectivores	Y	Functional group (M123)		1/3	1/3			
Small-footed myotis	Y	Functional group (M210)		2/3	1/3			
Townsend's western big-eared bat	Y	Functional group (M210A)		2/3	1/3			
Long-eared myotis	Y	Small-footed myotis		2/3	2/3			

Table D1-2-3 (continued)

WAG 10 Assessment Endpoint[b]	RISK	WAG ERA endpoint	WAG 1	WAG 2	WAG 3	WAG 4	WAG 5	WAG 6
Merriam's shrew (M222)	Y	Townsend's western big-eared bat		2/3	1/3			
	Y	Long-eared myotis		2/3	2/3			
	Y	Functional group (M222)		2/3	2/3			
Reptilian insectivores	U	Functional group (R322)		NA	NA			
Sagebrush lizard	U	Sagebrush lizard		NA	NA			
Avian Carnivores	N	Functional group (AV310,)		0/3	0/3			
Peregrine falcon	N	Peregrine falcon		0/3	0/3			
Northern goshawk	N	Northern goshawk		0/3	0/3			
	Y	Functional group (AV322)		1/3	0/3			
Bald eagle	N	Bald eagle		0/3	0/3			
Ferruginous hawk	N	Ferruginous hawk		0/3	0/3			
Loggerhead shrike	Y	Loggerhead shrike		1/3	0/3			
Burrowing owl	N	Burrowing owl		1/3	0/3			
Mammalian carnivores	Y	Functional group (M322)		1/3	0/3			
Reptilian carnivores	U	Functional group (R322)		NA	NA			
Avian omnivores	Y	Functional group (AV422)		1/3	0/3			
Mammalian omnivores	Y	Functional group (M422)		2/3	0/3			
	N	Functional group (M422A)		0/3	0/3			

Table D1-2-3. (continued).

WAG 10 Assessment Endpoint[b]	RISK	WAG ERA endpoint	WAG 1	WAG 2	WAG 3	WAG 4	WAG 5	WAG 6
Terrestrial invertebrates	U	NONE		NA	NA			
Integrity of wildlife prey base:	Y	Functional group (AV122)		2/3	1/3			
Birds, small mammals, invertebrates	Y	Functional group (M122)		2/3	2/3			
	Y	Functional group (M122A)		1/3	1/3			
	Y	Functional group (M123)		1/3	1/3			
	Y	Functional group (M422)		2/3	1/3			
	U	Invertebrates		NA	NA			

a. Number of COPCs for which average HQ is exceeded, i.e., 1 out of 3.

b. See Appendix D1 Attachment 3 for a discussion of OU 10-04 endpoints.

Y = HQ ≥ 1 for at least 1 COPC.

N = HQ < 1 for all COPCs. Highlighting indicates endpoints that would not be evaluated in the OU 10-04 ERA.

U = Unknown.

NA = Data (primarily TRVs) are not available to assess these endpoints.

Table D1-2-4. Example summary of risk to INEEL aquatic wildlife receptors based on average HQ for WAGs 2 and 3 sites of concern.

WAG 10 Assessment Endpoint[b]	RISK	WAG ERA endpoint	WAG 1	WAG 2	WAG 3	WAG 4	WAG 5	WAG 6
INEEL aquatic wildlife community structure, T/E and species of concern:								
Amphibians	U	Functional group (A232)		NA	---			
Great Basin spadefoot toad	U	Great Basin spadefoot toad		NA	---			
Avian herbivores	N	Functional group (AV143)		0/3[a]	---			
Trumpeter swan	Y	Trumpeter swan		1/3	---			
Avian insectivores	N	Functional group (AV233)		0/3	---			
White-faced ibis	N	White-faced ibis		0/3	---			
Black tern	N	Black tern		0/3	0/3			
Avian omnivores (shorebirds and waterfowl)	Y	Functional group (AV422)		1/3	---			
	N	Functional group (AV442)		0/3	---			

a. Number of COPCs for which the average HQ is exceeded, i.e., 0 out of 3.

b. See Appendix D1 Attachment 3 for a discussion of OU 10-04 assessment endpoints.

Y = HQ ≥ 1 for at least 1 COPC.

N = HQ < 1 for all COPCs. Highlighting indicates those receptors that would not be evaluated in the OU 10-04 ERA.

U = Unknown.

NA = Data (primarily TRVs) are not available to assess these endpoints.

--- = Endpoint was not in pathway for COPC.

Table D1-2-5. Example summary of risk to INEEL game populations and unique habitats based on average HQ for WAGs 2 and 3 sites of concern.

WAG 10 Assessment Endpoint[b]	RISK	WAG ERA endpoint	Number of COPCs for which Avg. HQ is exceeded					
			WAG 1	WAG 2	WAG 3	WAG 4	WAG 5	WAG 6
INEEL game species populations:								
Pronghorn	Y	Functional group (M122)		2/3[a]	2/3			
Elk	Y	Functional group (M122)		2/3	2/3			
Mule deer	Y	Functional group (M122)		2/3	2/3			
Sagegrouse	Y	Functional group (AV122)		2/3	1/3			
Waterfowl	Y	Functional group (AV422)		1/3	---			
	N	Functional group (AV143)		0/3	---			
INEEL unique and special habitats:								
Big Lost and Birchcreek drainages	U	NONE		---	---			
Caves	U	NONE		---	---			
Large areas of sagebrush steppe	Y	Plants		2/3	2/3			

a. Number of COPCs for which the average HQ is exceeded, i.e., 2 out of 3.

b. See Appendix D1 Attachment 3 for a discussion OU 10-04 assessment endpoints.

Y = HQ ≥ 1 for at least 1 COPC.

N = HQ < 1 for all COPCs. Highlighting indicates those endpoints that would not be evaluated in the OU 10-04 ERA.

U = Unknown.

NA = Data (primarily TRVs) are not available to assess these endpoints.

--- = Endpoint was not in pathway for COPC.

Table D1-2-3. (continued).

Appendix D1
Attachment 3

OU 10-04 ERA Endpoint Development

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Appendix D1
Attachment 3

OU 10-04 ERA Endpoint Development

D1-3-1. OU 10-04 ECOLOGICAL RISK ASSESSMENT ENDPOINT DEVELOPMENT

Assessment endpoints for the OU 10-04 Ecological Risk Assessment (ERA) must be defined in the final steps of the problem formulation phase of the assessment. Assessment endpoints are "explicit expressions of the actual environmental values that are to be protected" (EPA 1996). For ERA, assessment endpoints are the focus for risk characterization and link the measurement endpoints to risk management goals (EPA 1992).

Two elements are necessary to define an assessment endpoint: (1) the "valued ecological entity" (e.g. a species, a functional group, an ecosystem function or characteristic, a specific habitat, or a unique place), and (2) the characteristic of the entity that is important to protect and potentially at risk (e.g., reproductive viability) (EPA 1996).

A summary of INEEL-wide ecological resources to be protected is given in Table D1-3-1. The summary was compiled using the natural resource valuation methodology presented in Wyant et al. (1996; 1995) to identify and categorize INEEL natural resources in terms of their current potential economic and social values. Defining and managing INEEL natural resources in terms of ecosystem values, goods, and services appears to be a viable concept for incorporating differing trustee interests and expectations to define the products or benefits related to specific ecological resources (individual or groups of species, communities or other resource attributes) which, if adversely impacted through contaminant exposure, affect the product or benefit in question.

The entities representing INEEL ecological resources in Table D1-3-1 were then summarized to produce the following suite of high-level assessment endpoints encompassing both biotic and abiotic attributes of INEEL natural resources to be quantitatively or qualitatively evaluated in the OU 10-04 ERA:

- INEEL plant community structure and habitat value
- Wildlife and livestock forage production
- Plant species of concern (individuals and populations)
- Soil productivity and structure
- INEEL terrestrial wildlife community structure, threatened or endangered (T/E) and species of concern
- INEEL aquatic wildlife community structure, T/E and species of concern
- Integrity of INEEL wildlife prey base

Table D1-3-1. Summary of INEEL ecosystem values, goods, and services (after Wyant et al. 1996).

INEEL Assets	Products and Benefits	INEEL Resources
INEEL Ecosystem Values	Landscape diversity Species diversity Genetic diversity	INEEL plant communities (all species) INEEL sensitive plant species INEEL wildlife communities (all species) INEEL T/E and sensitive wildlife species INEEL soil communities
	Wildlife/endangered species food and habitat	INEEL native plant communities and prey base
	Pollination	INEEL pollinating insect species and populations
	Migratory Corridor	Pronghorn populations Elk populations Deer populations Waterfowl populations Sage grouse populations Migratory bird populations—songbirds, raptors
	Surface water	Big Lost River, Birch Creek Drainage, Big Lost River sinks wetland habitat
	Soil productivity	Plant, insect and soil communities
	Live animals	INEEL wildlife (all species)
	Unique and special habitats	Big Lost River drainage, bat and snake hibernacula, INEEL migratory bird habitat, foothills of Beaverhead and Lemhi mountains
INEEL Ecosystem Goods	Human food	Pronghorn Elk Deer Rabbits Waterfowl Mourning dove Sage grouse Cattle Sheep Native plants used for traditional food and medicine
	Furbearers	Bobcat, coyote
	Livestock forage	INEEL plant communities: Native and seeded grasses and forbs, soil productivity
	Surface water (quality/quantity, aquifer recharge)	Snake River aquifer
INEEL Ecosystem Services	Recreation—Hunting	Pronghorn populations Elk populations Deer populations Waterfowl populations Sage grouse populations
	Scientific Research	INEEL native wildlife and plant communities, large scale outdoor research sites; National Ecological Research Park (NERP)
	Heritage Value (cultural and religious, historical, uniqueness)	Native American religious sites, (caves, archaeological sites); Goodales Cutoff, EBR-I; NERP, National Important Bird Area
	Aesthetic	Scenery

- INEEL game species populations
- INEEL unique and special habitats.

By incorporating resource valuation associated with INEEL ecosystem assets, assessment endpoints are tailored to reflect several of the major recommended criteria for appropriate endpoint definition (EPA 1992, 1996) including ecological relevance, policy goals, and societal values.

Several of the resulting high-level endpoints encompass numerous ecological components (individual species, functional groups [see VanHorn et al. 1995] or other attributes) that will be evaluated independently by using representative species or indicators, subject to the following assumptions:

- All wildlife functional groups have been specifically addressed in the assessment endpoints except those in which all group members are migratory and/or seasonal and have abundance codes greater than 4 (Arthur et al. 1984). Species present at the INEEL for lesser times may be re-examined on a contaminant-by-contaminant basis if risk is shown in the OU 10-04 ERA.
- Assessment of resident species will be assumed to represent maximal exposure for INEEL populations. Resident and common species (those with abundance codes of less than 3 from Arthur et al. 1984) will serve as potential surrogates for other functional group members.
- All T/E and species of concern will be assessed at the individual and population levels.
- Soil communities, aquatic and terrestrial plants and invertebrates, and ground water will be quantitatively or qualitatively addressed.

These indicators represent individual species or attributes that have been selected to allow the assessment endpoint to be more intensely evaluated using refined exposure modeling. Preliminary OU 10-04 assessment endpoints, indicators and exposure models for which each indicator is appropriate are summarized on Table D1-3-2.

Additional EPA assessment endpoint criteria, including susceptibility to the stressor and accessibility to prediction and measurement will be incorporated using WAG ERA results to complete the hazard identification step of the OU 10-04 problem formulation (see Appendix D1, Section D1-3.3). Relevance of individual receptors to INEEL-wide contaminants and primary contaminant pathways will be established through evaluating Tier 1 (screening-level) and Tier 2 (WAG–level) assessment results (see Appendix D1, Sections D1-3.3). An example receptor pathway and endpoint association analysis is presented in Appendix D1, Attachment 2 (see Table D1-2-1). The OU 10-04 ERA endpoints will then be individually evaluated on a WAG-by-WAG and contaminant-by-contaminant basis to verify potential for exposure as shown in Table D1-3-3. This screening process is discussed further in Appendix D1, Attachment 2.

These endpoints are intended to represent all ecological, social and regulatory requirements relevant to INEEL contaminant issues and may be further prioritized to reflect policy goals, scientific and regulatory requirements, stakeholders expectations (social, cultural), and budget and scheduling criteria. This allows the focus to be placed on those endpoints most critical to the assessment and, in the case where all cannot be assessed, identify those that may be deferred, qualitatively assessed, or otherwise addressed. This endpoint development process is primarily a systematic exercise in combining specific regulatory, societal, and ecological requirements to produce a suite of assessment endpoints that will

Table D1-3-2. Preliminary summary of OU 10-04 assessment endpoints and indicators.

	WAG 10 Assessment Endpoint	Indicator	Exposure model
1.	INEEL plant community structure and habitat value	Plants	ms
2.	Wildlife and livestock forage production	Plants	ms
3.	Plant species of concern: Lemhi milkvetch Plains milkvetch Wing-seed evening primrose Spreading gilia Ute's ladies tresses	Plants (all)	ms
4.	Soil productivity and structure	NQ	NA
5.	INEEL terrestrial wildlife community structure, T/E and species of concern:		
	Avian herbivores (AV121, AV122)	Mourning dove	ms/f/h
	Mammalian herbivores (M121, M122, M122A) Pygmy rabbit	Pygmy rabbit	sc/ms/f/h
	Avian insectivores (AV210, AV210A, AV222) Black tern	Barn swallow Sage sparrow Black tern	ms/f ms/h sc
	Mammalian insectivores (M123, M210, M210A,M222)	Montane vole	ms/f/h
	Small-footed myotis	Small-footed myotis	sc
	Townsend's western big-eared bat	Townsend's western big-eared bat	sc
	Long-eared myotis	Long-eared myotis	sc
	Merriam's shrew (M222)	Merriam's shrew	sc
	Reptilian insectivores (R322) Sagebrush lizard	Sagebrush lizard	sc/ms/f/h
	Avian Carnivores (AV322)	Loggerhead shrike	sc/ms/h
	Peregrine falcon	American kestrel	ms/f
	Northern goshawk	Ferruginous hawk	sc
	Bald eagle	Burrowing owl	sc
	Ferruginous hawk		
	Loggerhead shrike		
	Burrowing owl		
	Mammalian carnivores (M322)	Long-tailed weasel	ms/f/h
	Gray wolf	Gray wolf	
	Reptilian carnivores (R322)	Gopher snake	ms/f/h
	Avian omnivores (AV422)	Black-billed magpie	ms/f/h
	Mammalian omnivores (M422)	Deer mouse	ms/f/h
	Terrestrial invertebrates	Beetles, grasshoppers	ms/f/h
6.	Integrity of wildlife prey base:	Cottontail	ms/f/h
	Birds (AV122), small mammals (M122, M122A, M123)	Montane vole	ms/f/h
	(M422), invertebrates	Deer mouse	ms/f/h
		Horned lark	ms/h
		Beetles, grasshoppers	ms/f/h

Table D1-3-2. (continued).

	WAG 10 Assessment Endpoint	Indicator	Exposure model
7.	INEEL aquatic wildlife community structure, T/E and species of concern:		
	Amphibians (A232)	Great Basin spadefoot toad	ms/f
	Great Basin spadefoot toad		
	Avian herbivores (AV143)	Blue-winged teal	ms/f
	Trumpeter swan	Trumpter swan	sc
	Avian insectivores (AV210, AV232, AV233)	Black tern	sc
	White-faced ibis	Red-winged blackbird	ms/f
	Black tern	White-faced ibis	sc
	Avian omnivores (shorebirds and waterfowl) *(AV442)*	American coot	ms/f
8.	INEEL game species populations:		
	Pronghorn	Pronghorn	ms/h
	Elk	Elk	ms/h
	Mule deer	Mule deer	ms/f/h
	Sage grouse	Sagegrouse	ms/f/h
	Waterfowl	Mallard	ms/f
		Blue-winged teal	ms/f
	Mourning dove	Mourning dove	ms/f/h
	Rabbits	Cottontail	ms/f/h
9.	INEEL unique and special habitats:		
	Big Lost and Birch Creek drainages	NQ	NA
	Caves	NQ	NA
	Large areas of sagebrush steppe	Plants, qualitative	NA

NA = Not Applicable

NQ = Not Quantitatively modeled for OU 10-04 ERA. Will be addressed qualitatively.

ms = modeled species

sc = species of concern

f = facilities

h = natural habitat

produce the information and results required from the assessment. The goal is to preferentially select endpoints that specifically address INEEL contaminant issues and meet most or all of the major EPA criteria. Selection of final assessment and measurement endpoints will be addressed in detail as part of the OU 10-04 ERA.

Table D1-3-3. Example summary of risk to INEEL aquatic wildlife receptors based on average HQs for WAG 2 and 3 COPCs.

OU 10-04 Assessment Endpoint	Risk	WAG ERA endpoint	WAG 1	WAG 2	WAG 3	WAG 4	WAG 5	WAG 6
INEEL aquatic wildlife community structure, T/E and species of concern:								
Amphibians	U	Functional group (A232)		NA	—			
Great Basin spadefoot toad	U	Great Basin spadefoot toad		NA	—			
Avian herbivores	N	Functional group (AV143)		0/3[a]	—			
Trumpeter swan	Y	Trumpter swan		1/3	—			
Avian insectivores	N	Functional group (AV233)		0/3	—			
White-faced ibis	N	White-faced ibis		0/3	—			
Black tern	N	Black tern		0/3	0/3			
Avian omnivores (shorebirds and waterfowl)	Y	Functional group (AV422)		1/3	—			
American coot	N	Functional group (AV442)		0/3	—			

Y = HQ ≥ 1 for at least 1 COPC.

N = HQ < 1 for all COPCs. Highlighting indicates endpoints that would not be evaluated in the OU 10-04 ERA.

U = Unknown

a. Number of COPCs for which Avg. HQ is exceeded (i.e. 0 of 3)

D1-3-2. REFERENCES

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Appendix D1
Attachment 4

OU 10-04 Summary of Field Activities for 1997 Ecological Sampling

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OU 10-04 Summary of Field Activities for 1997 Ecological Sampling

D1-4-1. INTRODUCTION

Sampling was identified as a data gap in the *Scope of Work* (Barna et al. 1997). To fill this data gap, sampling was conducted in accordance with the *Field Sampling Plan* (FSP) (DOE-ID 1997) and the results documented in Attachment 9 to Appendix D1 of this work plan. No data gaps are assumed to remain for Operable Unit (OU) 10-04, because the data are expected to represent Waste Area Groups (WAGs) 6 and 10.

The 1997 ecological field sampling locations for OU 10-04 were selected on the availability of biotic media representing primary pathways for contaminant transfer through the Idaho National Engineering and Environmental Laboratory (INEEL) food web. Both the ecological study area (ESA, areas within the INEEL boundary) plots and the reference study area (RSA, areas outside the INEEL boundary) plots were sampled to provide background, i.e., baseline comparisons. Rationale for media selection and details of the sampling methodologies are documented in the FSP (DOE-ID 1997).

D1-4-2. PRESAMPLING ACTIVITIES

Before the ESA and RSA plots were sampled, five activities were completed: (a) plot selection, (b) an archeological and cultural resources survey, (c) an ordnance survey, (d) a global positioning system (GPS) survey, and (e) a vegetation survey. These activities are described in the rest of this section.

D1-4-2.1 OU 10-04 Plot Selection

Factors considered in the ESA plot selection included:

- The Idaho Nuclear Technology and Engineering Center (INTEC), (formerly the Idaho Chemical Processing Plant [CPP]) plume area as defined for the OU 10-06 windblown area (Jessmore 1996)
- Vegetation
- Wind pattern.

The INTEC plume was identified as a conservative example of soil contamination across the INEEL. The primary wind direction (from the southwest) was ascertained to "select a downwind" section of the plume. Factors considered in selecting the RSA plot included:

- Location relative to the INEEL
- Vegetation

- Wind pattern.

Although random site selection was desirable to strengthen statistical design, certain habitat characteristics were required to insure that all media (i.e., species) could be collected. Because the existence and density of appropriate small mammal and insect species was difficult to predict prior to sampling, vegetation was used as the primary selection criterion for RSA plots. It was assumed that plots had the appropriate small mammals and insects, based on the vegetation community.

Final RSA plot selection was based on the location of vegetation species, which also occurred on the INEEL Site. The primary candidates were sagebrush (found at all sites in adequate numbers) and three species of grass: thick-spike wheatgrass (*Elymus lanceolatus*), crested wheatgrass (*Agropyron cristatum*), and Poa (*Poa* spp.). Ground surveys of RSAs and ESAs resulted in the selection of crested wheatgrass (*A. cristatum*).

Potential locations for the RSA were identified off-Site and out of the primary wind pattern, based on INEEL wind roses.

Factors not considered in the RSA selection process included:

- Soil

- Topography.

Although soil properties are important to contaminant behavior and uptake by biota, central INEEL soil types are unique to the area of the Big Lost River drainage. Similar soils to those found on the ESA are located off-Site at substantial distances both to the east and west of the INEEL.[a] Logistic constraints and vegetation communities were the primary criteria upon which the RSA was selected. Similar soil and topography were considered to be of less importance.

D1-4-2.2 Plot Size and Site Selection

An arbitrary plot size of 0.4 ha (1 acre) is assumed to be reasonably representative of INEEL and off-INEEL biotic and abiotic heterogeneity. Satellite image resolution (30 × 30 m [98 × 98 ft] pixel size) and the home range size of the sampled species were also considered in defining plot size.

The senior ecologist and risk assessor examined all five plots for sampling potential; plant species were identified and the plots were characterized. The original field data sheets are contained in the field team leader (FTL) logbook (#ER-85-97). The ESA and RSA were examined to assess the plant species to collect. The vegetation type and distribution within the INTEC plume at the ESA differ from the available RSA plots. Although the dominant grass species is thick-spike wheatgrass (*E. lanceolatus*), this species was difficult to locate at potential RSA plots. Based on species availability at both the ESA and RSA, crested wheatgrass (*A. cristatum*) was selected as the grass species for sampling. However, because this species was not common on several ESA plots, it became necessary to extend the collection at these sites to the surrounding grids of the sector to obtain the required sample. The shrub species selected, as discussed in the FSP, was present at all plots. Based on this rationale, none of the ESA plots were moved.

a. Personal communication between N. L. Hampton and D. J. Jeppeson, April 1997.

D1-4-2.2.1 Ecological Study Area Plots

The INTEC plume, identified as a radionuclide contaminated soil plume during the *OU 10-06 Remedial Investigation/Feasibility Study (RI/FS)* (Jessmore et al. 1996) was selected as a conservative example of soil contamination across the INEEL and designated as the ESA. A grid, composed of sections 64×64 m^2 (210×210 ft^2), or approximately 0.4 ha (1 acre) each, was placed over the ESA, as shown in Figure D1-4-1. Permanent structures such as buildings, pavement, and other surface structures were excluded from the grid. One sample plot was randomly selected from each of the five sectors delineated within the wedge-shaped area extending northeast from INTEC. The plot location was established using GPS coordinates (see Section D1-4-3.1 for details).

D1-4-2.2.2 Reference Study Area Plots

Maps of the potential RSAs were overlain with 0.4 ha (1 acre) plot grids. Five plots were then randomly selected using Geographic Information System (GIS) coordinates associated with each plot center. Two offsite areas were evaluated. Because of the size of the INEEL ESA, an RSA of 2,590 km_2 (640 acres [one section]) was selected. Originally, a location on Bureau of Land Management (BLM) lands in portions of Sections 4 and 9 (T1N R32E BB&M) was selected. During the early spring, these sections were examined and considered adequate.

When examined for final plot selection, it was determined that these RSA sections did not contain crested wheatgrass (*A. cristatum*) nor thick-spike wheatgrass (*E. lanceolatus*); therefore, alternate RSA plots were selected. An attempt was made to locate RSA plots with the grass species initially selected on the ESA; however, this was not possible and crested wheatgrass (*A. cristatum*) was substituted. The final RSA location was on BLM lands in Sections 21, 22, and 23 as shown on Figure D1-4-2. A grid, similar to the one placed on the ESA, was placed over the three sections and the grids were numbered, excluding a 150 m (492 ft) portion of Goodales' Cutoff Historic Trail. From the acceptable grids, five plots were randomly selected and GPS was used to locate the plot centers. The senior ecologist and risk assessor then examined the plots for suitability.

D1-4-2.2.3 Preliminary Field Evaluation

The first RSA (off-Site) location selected included Sections 9 and 4 of the Middle Butte Quadrangle. Although BLM and Idaho Department of Fish and Game (IDFG) approvals for small mammal trapping were complete, this area was subsequently rejected since field reconnaissance revealed that no grass species common to the ESA plots could be found in sufficient quantities (see Section D1-4-2.2.2). A second area encompassing Sections 21 through 23 of the Atomic City Quadrangle (see Figure D1-4-2) was identified through field surveys. Section 23 was subsequently omitted from consideration, since crested wheatgrass (*A. cristatum*) was not observed during the field survey. The remaining sections (21 and 22) were gridded and five plots were subjectively selected. A preliminary survey of each site was conducted to ensure that the appropriate species were present. If a plot was not suitable, due to lack of crested wheatgrass (*A. cristatum*) or other reasons (i.e., excessive grazing disturbance), the next location to the north and then clockwise from the original plot was selected.

D1-4-2.2.4 Agency Approvals

The BLM and IDFG were consulted, and gave approval to amend the existing trapping permit to apply to the new site. Copies are contained in the project file.

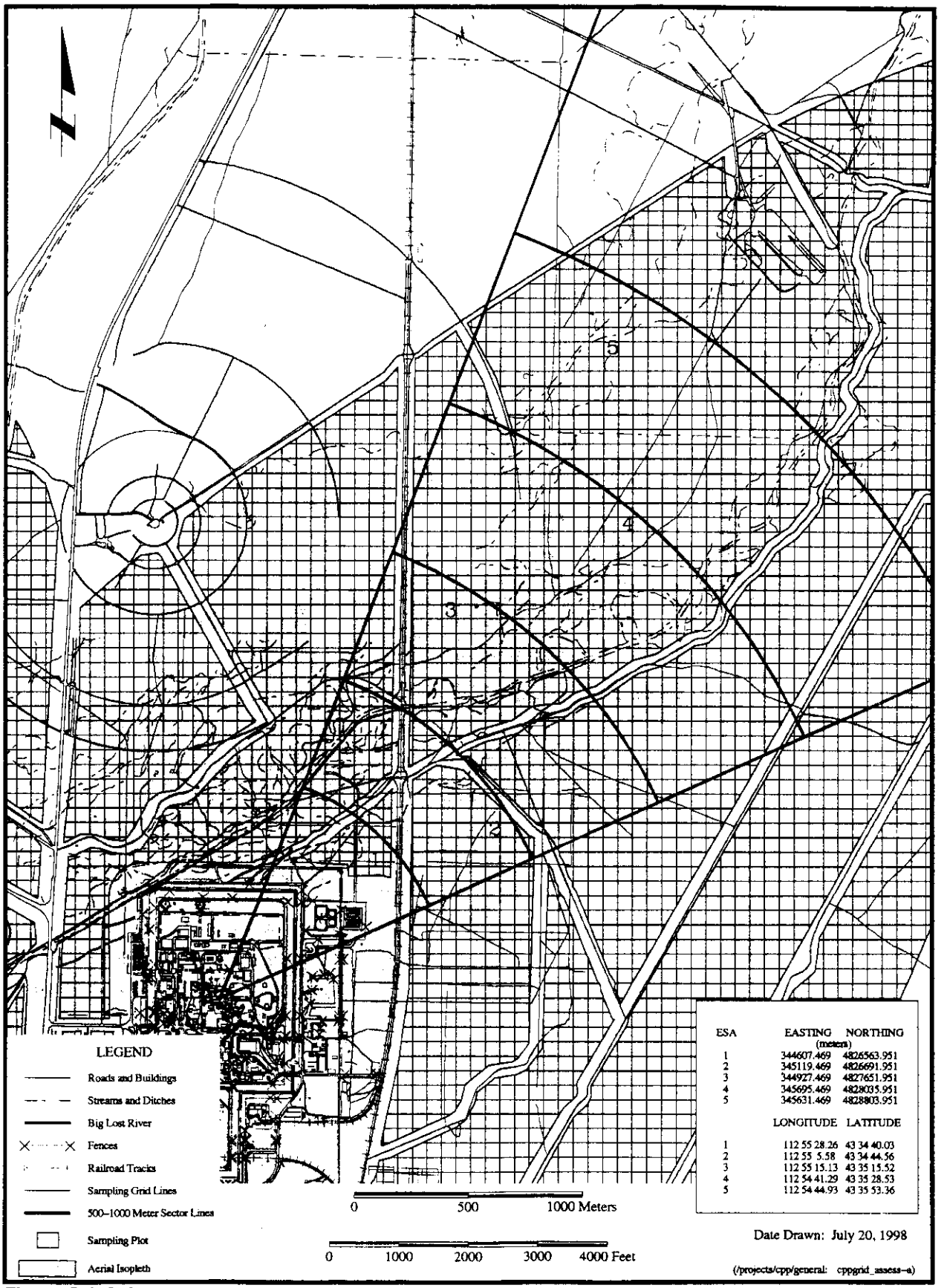

Figure D1-4-1. OU 10–04 1997 ecological study area (ESA) plots northeast of the INTEC radioactive plume.

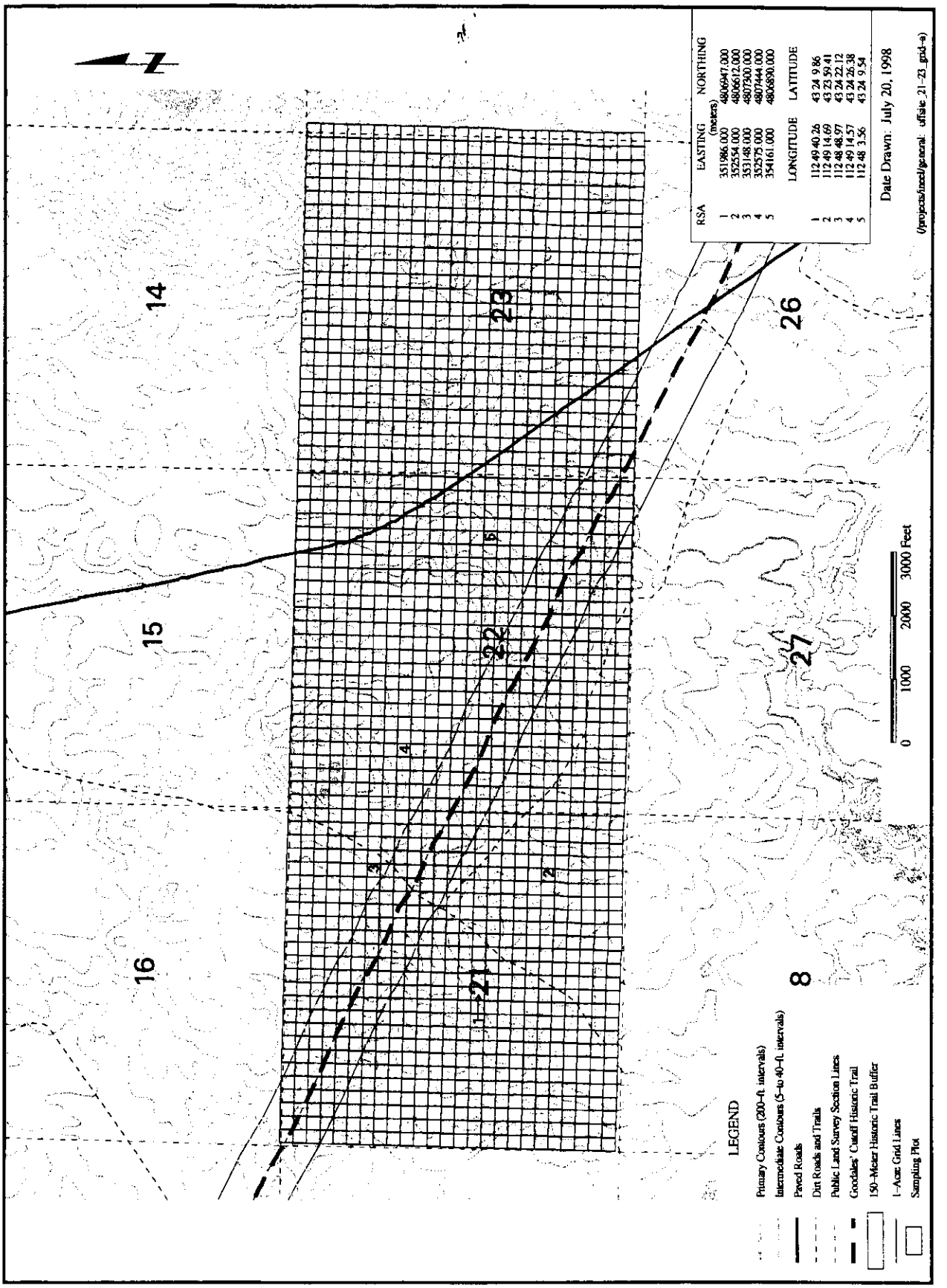

Figure D1-4-2. 1997 OU 10–04 reference study area (RSA) plots south of the INEEL.

D1-4-3. SITE CHARACTERIZATION

D1-4-3.1 Global Positioning System Plot Location

ESA (on-Site) plot locations were selected from coordinates associated with the GIS gridding process described in Subsection D1-4-2.2. The survey consisted of locating the centers of selected plots with Ashtech Z-12 geodetic GPS receivers and then staking the points. These receivers locate the coordinates in Real Time Z Mode and have a published accuracy of 1 cm horizontal ± 1 ppm. RSA plot centers were determined with a Trimble Pathfinder GPS and corrected using the base-station files from the INEEL Research Center (IRC) (see Figure D1-4-2). The GPS coordinates were collected at the ESA plots on June 16, 1997, and at the RSA plots during the week of July 21, 1997. Additional surveying for the relocated ESA cottontail traps was completed on September 15, 1997.[a]

D1-4-3.2 Archeological and Cultural Resources Surveys

The survey for archeological and cultural resources was conducted on June 20, 1997, at the ESA plots and on July 16, 1997, at the RSA plots by the INEEL archeologist. The survey consisted of intensive examination centered at each of the proposed sampling plots of an 80 × 80-m (262 × 262-ft) area (i.e., 40-m (131-ft) transects that were less than 20-m (66-ft) intervals apart in all directions. The investigation conformed to guidelines outlined in the Federal Register (Volume 48, No. 190) to comply with the National Historic Preservation Act. No cultural sites or artifacts were identified on any of the ESA or RSA plots. Therefore, the 10 plots were cleared for sampling as stated in the FSP. The results of these surveys are documented in field notes contained in the FTL logbook (#ER-85-97) and electronic notes from B. R. Pace, the INEEL archeologist.

D1-4-3.3 Ordnance Survey

The survey for ordnance was conducted by the unexploded ordnance (UXO) specialist in July 1997, using a Schonstadt magnetometer, 52CX. The magnetometer was used per the instructions and was adjusted to penetrate 0.61 m (2 ft) below land surface. Eight transects around the plot center were surveyed at 45° angles. No UXO was identified at the ESA plots and, therefore, the plots were cleared for sampling as stated in the FSP. An ordnance survey was not required nor conducted at the RSA plots.

D1-4-3.4 Plot Sampling Layout

The ESA plot sampling locations were staked and/or flagged during the week of July 14, 1997. Traps were placed and set during the week of July 21, 1997. The RSA plot 5 was staked during the week of July 21, 1997, and RSA plots 1 through 4 were staked during the week of July 28, 1997. Trap placement was completed August 6, 1997. Figure D1-4-3 shows the terrestrial sample plot design.

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b. The technician completed two weeks of training and the procedures are contained in the Ashtech Seismark Survey System Field Guide and Office Guide reference manuals published April 1995.

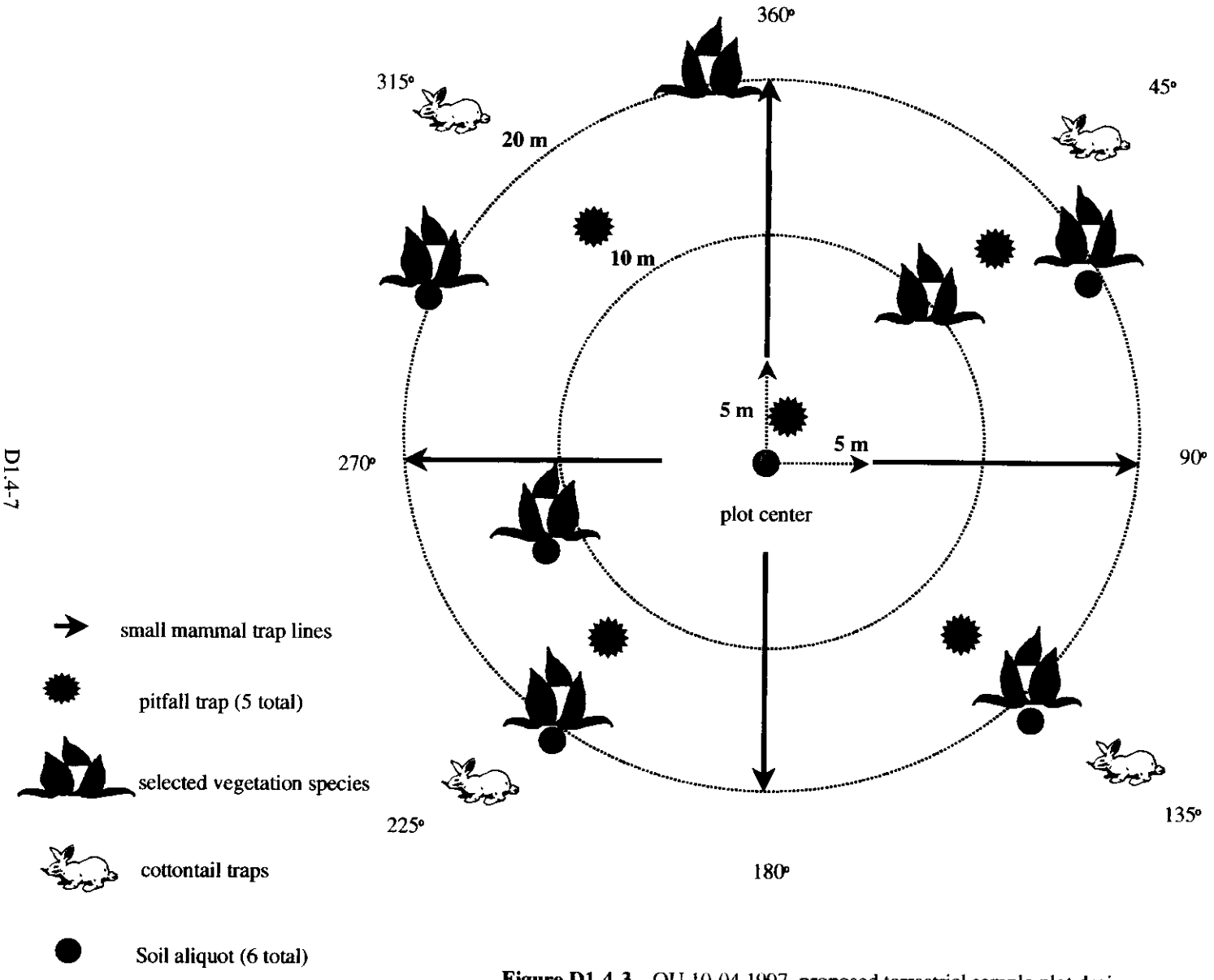


Figure D1-4-3. OU 10-04 1997 proposed terrestrial sample plot design.

D1-4-3.5 Vegetation Characterization

A routine survey of vegetative characteristics including abundance, species (Plummer et al. 1977), and estimated cover was conducted for areas surrounding ESA and RSA plot centers. The abundance of each vascular plant species occurring on the site was ranked using a four-point scale (4 = dominant to 1 = rare). The scale is a simplification of cover/abundance scales (Mueller-Dombois and Ellenberg 1974) based on intuitive abundance categories rather than cover-class estimates. Survey data sheets are included in the FTL logbook (#ER-85-97). The INEEL vegetation map cover classes associated with the center coordinates for ESA plots shown in Table D1-4-1, were determined by overlaying plot GPS coordinates on the INEEL vegetation map and comparing species composition of the mapped cover class to the species list compiled during the site vegetation survey. No vegetation mapping has been conducted outside INEEL borders, so cover classes associated with RSA plots shown in Table D1-4-2 were based solely on comparison to species composition from the INEEL vegetation classes.

D1-4-3.6 Soil Characterization

The soil was characterized at the ESA plots on October 21 and 22, 1997, and at the RSA plots on October 28 and 29, 1997. Initially, a soil pit was excavated to approximately 0.45 m (1.5 ft) at each plot. At the RSA plots, soil was then hand augered to bedrock, if possible.

D1-4-3.6.1 ESA Plots

Hand augering was completed to refusal at the ESA plots, which are situated in the alluvial deposits of the Big Lost River. Rathburn (1991) mapped the Big Lost River deposits while modeling the extent of late Pleistocene cataclysmic flooding. Geomorphic investigation combined with modeling indicate that the peak discharge of the Big Lost River was about 60,000 to 100,000 m^3/sec (2 to 4 million cubic feet per second [cfs]). Rathburn's Qa mapping unit represents deposits that are associated with the most extensive cataclysmic flood identified along the Big Lost River. Deposits within the Qa unit consist of a thick basaltic sand and silt cover armored by oxidized fluvial gravels. Soils within the Qa unit are moderately well-developed, with calcic horizons containing 1-mm (0.04 in.) thick calcic rinds on the gravel. Rathburn's Qb deposits are characterized by a light tan "clayey silt", and highly calcareous cover exhibiting mud cracks on the surface. Fluvial gravel surface armor is present in places, and is likely the result of wind deflation.

Mapping was initially unclear for ESA-1 and ESA-2 due to delineation of the Qa and Qb units being somewhat obscured near ESA-1 by development around the ESA facility. Field investigation of these sites revealed that these sites are Qa deposits. Plots ESA-3, ESA-4, and ESA-5 are the more recent Qb deposits (Typic Torrifluvents).

D1-4-3.6.2 RSA Plots

Soil maps have not been published that include the reference study area plots. The extent of the mapping for the Bingham Area, Idaho soil survey ends a few miles east of the RSA plots, and the BLM has not yet published their maps, which would include the RSA plots. It is likely that the soils at the RSAs are similar to the soils just east (i.e., the Polatis and Pancheri series). Polatis soils are limy, silt loams, between 51 and 102 cm (20 and 40 in.) deep. Pancheri soils are limy, silt loams, greater than 127 cm (50 in.) deep. Both soils are classified as coarse-silty, mixed, frigid Xerollic Calciorthids. Plots RSA-1 and RSA-5 are Pancheri soils, while plots RSA-2, RSA-3, and RSA-4 are Polatis soils. All RSA soils have been formed in loess and overlie basaltic bedrock.

Table D1-4-1. Summary of INEEL ERA vegetation cover classes and vegetation survey results for ESA plots.

Site	ERA Vegetation Cover Class[a]	INEEL Expanded Vegetation Cover Classes	Dominant Species in INEEL Cover Class	Dominant Species Surveyed on ERA
ESA-3	Grasslands	Steppe Basin wildrye Grassland	*Leymus cinereus* *Descurainia sophia* *Sisymbrium altissimum* *Elymus lanceolatus* *Artemisia tridentata* ssp. *wyomingensis* *Elymus elymoides* *Chrysothamnus viscidiflorus*	*Elymus lanceolatus* *Hesperostipa comata* *Artemisia tridentata* ssp. *wyomingensis*
ESA-1 & ESA-5	Sagebrush/rabbitbrush	Sagebrush-steppe off lava Sagebrush-winterfat Sagebrush-rabbitbrush	*Artemisia tridentata* ssp. *wyomingensis* *Chrysothamnus viscidiflorus* *Bromus tectorum* *Sisymbrium altissimum* *Achnatherum hymenoides*	*Artemisia tridentata* ssp. *wyomingensis* *Chrysothamnus viscidiflorus* *Elymus lanceolatus*
ESA-2 & ESA-4	Sagebrush-steppe on lava	Sagebrush-steppe on lava	*Artemisia tridentata* ssp. *wyomingensis* *Achnatherum hymenoides* *Chrysothamnus viscidiflorus*	*Artemisia tridentata* ssp. *wyomingensis* *Chrysothamnus viscidiflorus*

a. See the INEEL vegetation and fire map with study area boundaries (/ul/gis1/idaho:veg-acres).

Table D1-4-2. Summary of INEEL ERA vegetation cover classes and vegetation survey results for RSA plots.

Site	ERA vegetation cover class[a]	INEEL expanded vegetation cover classes	Dominant species in cover class	Dominant species surveyed
RSA-1	Grasslands	Steppe Basin wildrye Grassland	*Leymus cinereus* *Descurainia sophia* *Sisymbrium altissimum* *Elymus lanceolatus* *Artemisia tridentata* ssp. *wyomingensis* *Elymus elymoides* *Chrysothamnus viscidiflorus*	*Artemisia tridentata* ssp. *wyomingensis* *Agropyron cristatum*
RSA-2	Sagebrush/rabbitbrush	Sagebrush-steppe off lava Sagebrush-winter fat Sagebrush-rabbit brush	*Artemisia tridentata* ssp. *wyomingensis* *Chrysothamnus viscidiflorus* *Bromus tectorum* *Sisymbrium altissimum* *Achnatherum hymenoides*	*Artemisia tridentata* ssp. *wyomingensis* *Chrysothamnus viscidiflorus*
RSA-3, RSA-4 & RSA-5	Sagebrush-steppe off lava	Sagebrush-steppe off lava	*Artemisia tridentata* ssp. *wyomingensis* *Achnatherum hymenoides* *Chrysothamnus viscidiflorus*	*Artemisia tridentata* ssp. *wyomingensis*

a. The INEEL vegetation map does not extend beyond the INEEL boundaries to include the RSA. These sites were assigned to a class based on dominant vegetation types, soil and geology of the area.

D1-4-3.7 Voucher Specimens and Archival Samples

Crested wheatgrass voucher specimens were collected due east of plot ESA-1, near the road and northeast of plot ESA-1, near the intersection of two gravel roads on October 16, 1997. Sagebrush voucher specimens were collected from plot ESA-4 on July 28, 1997. No specimens were retained; but photographs of the collected species were archived in the ecologist's library and OU 10-04 project file.

D1-4-4. 1997 FIELD SAMPLING SUMMARY AND RESULTS

All sampling activities were conducted according to the FSP (DOE-ID 1997) and the associated technical procedure (TPR-145). Any deviations were approved by the senior ecologist and recorded in the two FTL daily logbooks (#ER-84-97 and ER-85-97) and the three sample and shipping logbooks (#ER-86-97, ER-87-97 and ER-91-97). A brief description of the activities that deviated from the above mentioned plan and procedure are detailed below.

Originally, the plots were designed as described in the FSP (see Figure D1-4-3). After 1 to 2 weeks of sample collection, four additional pitfall traps were installed at the ESA plots to increase beetle capture. Figure D1-4-4 shows the final terrestrial sample plot design at the ESA plots.

D1-4-4.1 Vegetation and Soil Sampling

All ESA and RSA vegetation samples were obtained with the exception of wild onions. Collection of onion samples was postponed, since, at the time other field sampling was conducted, the above ground plant parts were senescent.

D1-4-4.1.1 ESA Plot #1

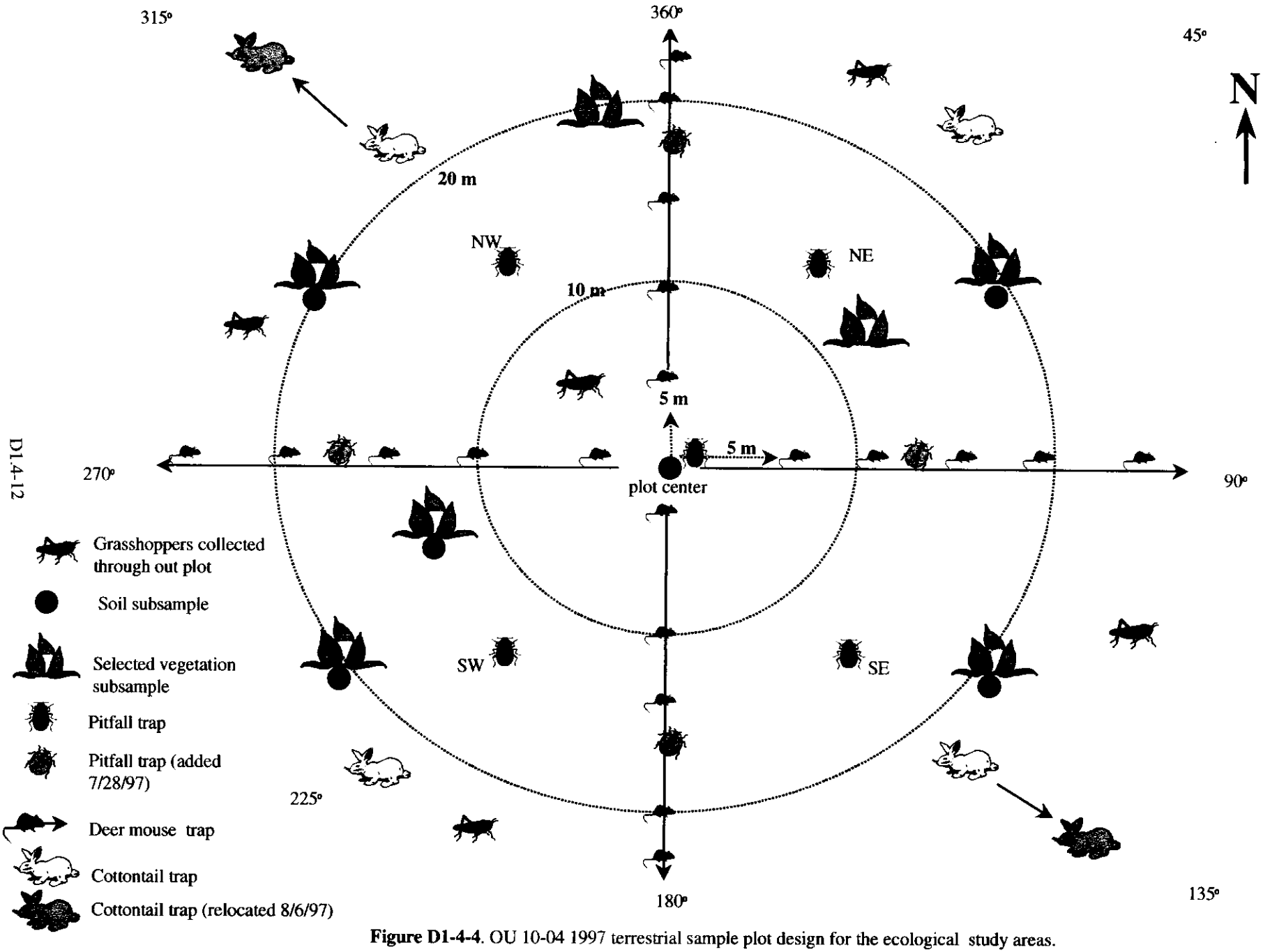
Limited crested wheatgrass was located on this plot. Three plants on the plot were collected and contributed 73 g (2.6 oz) to the total sample. The first sample (19 g [0.8 oz]) was located approximately 1.5 m (5 ft) south of the plot center, the second sample (29 g [1 oz]) was located approximately 49 m (161 ft) southeast of the plot center, and the third sample (25 g [0.9 oz]) was located 51 m (167 ft) east of the plot center. The balance of the sample was collected from plants on the road located approximately 48 m (157 ft) southwest of the plot center. Three soil and sagebrush samples were collected proximal to the crested wheatgrass sample locations. The fourth soil and sagebrush samples were collected adjacent to the road toward the center of the plot.

D1-4-4.1.2 ESA Plot #2

Crested wheatgrass samples were collected from three locations to yield 165 g (5.8 oz). Approximately 9 m (30 ft) southeast of the plot center, 57 g (2 oz) of crested wheatgrass were collected. Over 100 g (3.5 oz) of crested wheatgrass was also collected approximately 50 m (164 ft) northwest of the plot center (52 g [8 oz]) and approximately 50 m (164 ft) northeast of the plot center (56 g [1.9 oz]). Soil and sagebrush samples were collected proximal to the crested wheatgrass sample locations.

D1-4-4.1.3 ESA Plot #3

No crested wheatgrass was contained on this plot. Sagebrush was collected uniformly from four shrubs located between 15 and 25 m (49 and 82 ft) around the plot center. Soil was collected proximal to



D1.4-12

Figure D1-4-4. OU 10-04 1997 terrestrial sample plot design for the ecological study areas.

the sagebrush. Approximately 100 m (328 ft) west of the edge of the plot on the road by the railroad tracks (43 35 145, 112 55 26 reading taken with Garmin GPS), one-half of the crested wheatgrass sample (75 g [2.6 oz]) was collected. The balance of the crested wheatgrass sample (75 g [2.6 oz]) was collected from an old road on the southeast side of the plot, also approximately 100 m (328 ft) from the edge of the plot (43 35 19.5, 112 55 05.1 reading taken with Garmin GPS).

D1-4-4.1.4 ESA Plot #4

Crested wheatgrass samples were collected from three locations on this plot. The first crested wheatgrass sample was located 49 m (161 ft) east of the plot center. Within 10 m (32.8 ft) of this isolated crested wheatgrass sample, a sagebrush shrub was sampled. The second crested wheatgrass sample was located 27 m (89 ft) northwest of the plot center and the third wheatgrass sample was 31 m (102 ft) southwest of the plot center. Sagebrush and soil were collected proximal to the second and third crested wheatgrass sample locations.

D1-4-4.1.5 ESA Plot #5

No crested wheatgrass was found on this plot. Sagebrush was collected from four shrubs distributed uniformly between 15 and 25 m (49 and 82 ft) around the plot center. Soil samples were collected proximal to the sagebrush. Approximately 10 m (32.8) outside the southeast quadrant of the plot, 110 g (3.9 oz) of crested wheatgrass was collected. Another plant, located approximately 200 m (656 ft) southeast of the plot center, contributed the remainder (40 g [1.4 oz]) of the crested wheatgrass sample.

D1-4-4.1.6 RSA Plots #1 through 5

Crested wheatgrass was fairly abundant at these plots and was collected within the plots. Both soil and sagebrush samples were proximal to the crested wheatgrass samples. Soil profiles for the ESA and RSA plots are contained in Attachment 4A of Appendix D1.

D1-4-4.2 Insects

The collection of beetles and grasshoppers originally was restricted to the 0.4 ha (1 acre) plots. Darkling beetles (*Eleodes* spp.) were the most commonly collected species. Grasshoppers collected were primarily from the family Acrididae. At the ESA plots, 5 pitfall traps were initially installed per the FSP. Deviations from this methodology are detailed in Subsection D1-4-4.4.

D1-4-4.3 Small Mammals

D1-4-4.3.1 Deer mice

Collection of deer mice (*Peromyscus maniculatus*) was conducted on both the ESA and RSA plots, using methodology documented in the FSP. Deviations to the methodology are detailed in Subsection D1-4-4.4.

D1-4-4.3.2 Cottontails

Collection of cottontails (*Sylvilagus nuttallii*) on the ESA plots deviated from the methodology presented in the FSP (see Subsection D1-4-4.4). At the RSA plots, cottontail collection was conducted in accordance with the methodology documented in the FSP.

D1-4-4.4 Sampling Deviations/Changes

Per the FSP, the original deer mouse traps at the ESA plots and RSA plots were placed between 5 and 25 m (16 and 82 ft) from the plot center. On August 6, 1997, 20 traps were added to ESA-5 since it was a duplicate sampling plot. On August 27, 1997, 20 traps were added to RSA-2 and RSA-5, since no mice had been captured after 3 weeks of sampling. Traps were extended from 30 to 50 m (98 to 164 ft) in the north, east, south, and west directions from the plot center at plots ESA-5, RSA-2, and RSA-5.

After approximately 3 weeks of sample collection, since no cottontails were captured at the original ESA locations, two of the four traps were relocated outside the 50 m (164 ft) radius of the plots. After an additional 7 weeks of sample collection, cottontails still had not been captured at the original or 50 m (164 ft) locations, so two to three more traps were located at potential cottontail habitat within the ESA plot sectors, except at plots ESA-1 and ESA-5. At plot ESA-1, two rabbit traps were placed south of building CPP-1656 and at ESA-5, two rabbit traps were placed at the Experimental Field Station, approximately 805 m (0.5 mi or 2,640 ft) northeast of ESA-5 sector perimeter. Figure D1-4-5 shows the final capture locations for cottontails.

To increase beetle collection at the ESA plots, 1 week of sample collection, four additional pitfall traps were installed between the 15 and 20 m mouse traps. In addition, since plot ESA-1 was the smallest sector, beetles were also collected adjacent to the CPP-1653 office, approximately 880 m (0.55 mi or 2,890 ft) south-southwest of plot ESA-1.

No pitfall traps were installed at the RSA plots, since beetles were easily collected.

After approximately 6 weeks of meager sampling, collection of both beetles and grasshoppers was expanded in all directions within a sector at all ESA plots and RSA plots

D1-4-4.5 Site Abandonment and Cleanup

D1-4-4.5.1 ESA Plots

Mouse traps were removed between August 1 and 14, 1997. Cottontail traps were removed between September 3 and 29, 1997. Pitfall traps were covered on October 9, 1997, and removed November 5, 1997. On October 9 and November 5, 1997, the debris from the ESA plots, including but not limited to cardboard and pressed foam beetle habitat, plastic baggies, tent stakes, and colored flagging, was removed from the plots.

One 1.2 m (4 ft) metal post, tagged with a plot number, remains at each ESA plot center.

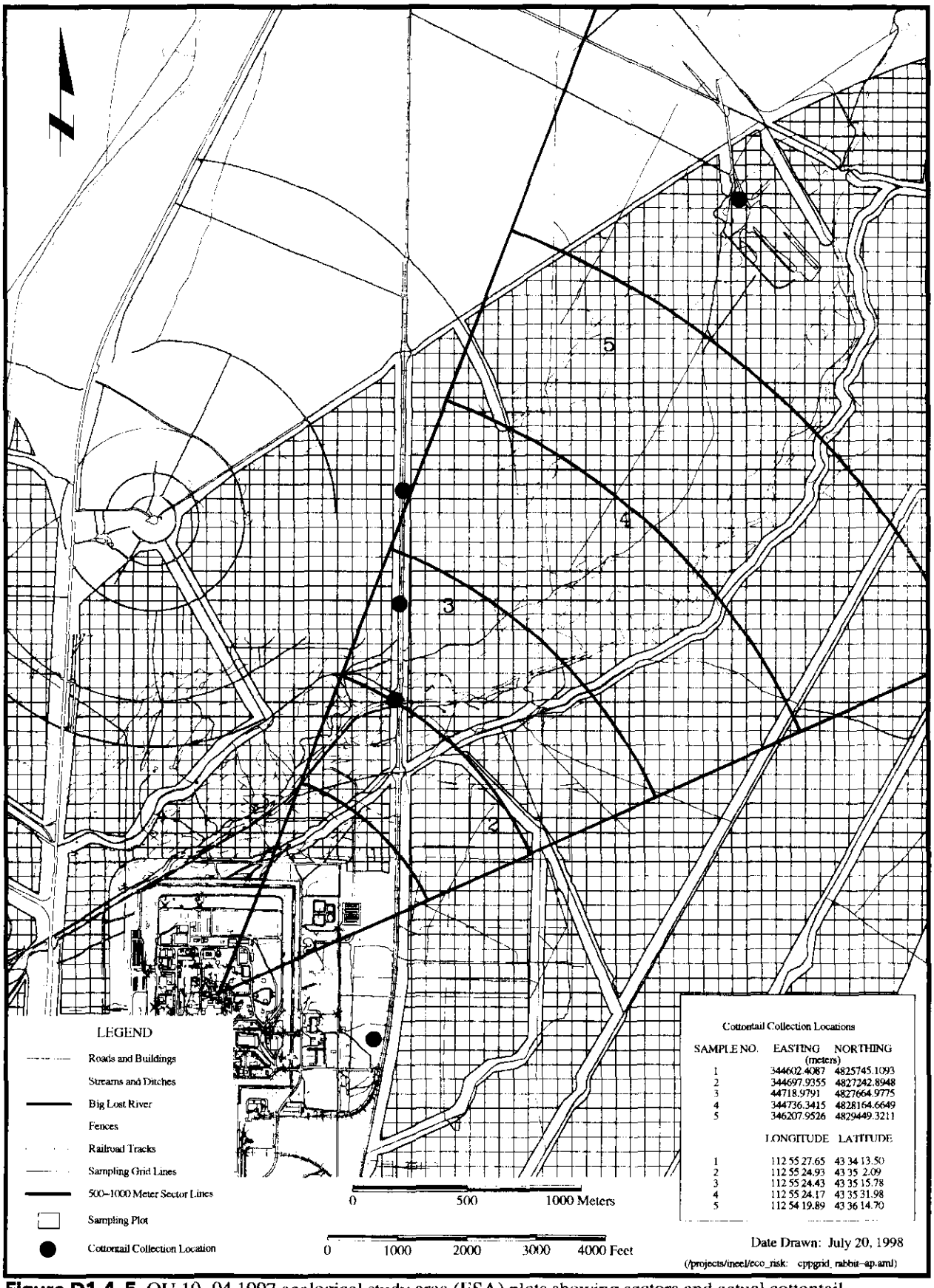


Figure D1-4-5. OU 10–04 1997 ecological study area (ESA) plots showing sectors and actual cottontail collection locations.

D1-4-4.5.2 RSA Plots

Mouse traps were removed between September 3 and 20, 1997. Cottontail traps were removed between August 20 and September 19, 1997. Debris, consisting of tent stakes and colored flagging, was removed from the RSA plots following trap removal.

One 1.2 m (4 ft) metal post, tagged with a plot number, remains at each RSA plot center.

D1-4-5. REFERENCES

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Appendix D1
Attachment 4A

Soil Profiles

Appendix D1
Attachment 4A

Soil Profiles

SOIL PROFILES FOR THE ECOLOGICAL STUDY AREA AND REFERENCE STUDY AREA PLOTS

The soil profiles were described between October 22 and 29, 1997. The following was transcribed from notes attached to the FTL logbook (#ER-85-97).

ESA Plots

ESA Plot #1. Big Lost River alluvium (Qa deposit). Minimal amount of armor consisting of 1/4 to 1 in. diameter pebbles concentrated in the mud cracks. Cryptogams also concentrated in the cracks. Stones are most prevalent around ant mounds; some of the pebbles near the ant mounds have carbonate coatings, which are not oriented in any particular direction (i.e., the carbonate coats are not consistently face up or face down). Significant amounts of stones with carbonates were not observed away from the ant mounds. No armoring observed around the plot center stake, where the soil profile was located. The plot also contained some earth mounds that are the result of rodent burrows.

Note on classification: Soil moisture regimes on the INEEL are not well-characterized, thus classifying the ESA soils more specifically than the soil order is often not possible. The ESA plot soils could be either the xeric or aridic moisture regime.

Classification—Coarse-loamy over loamy-skeletal Typic or Xeric Haplocalcid.

A 0 to 4 in. dark grayish brown (10YR 4/2) (dry) to very dark grayish brown (10YR 3/2) (moist), fine sandy loam (about 10 to 13% clay with fine sands and silts). Moderate platy and weak granular structure. Moderate, medium-sized (1/16 in.) roots; very few stones (one 1 in. stone at base of the horizon; the bottom of the stone reacts with HCl, indicating deposition of carbonate on the stone and correct orientation of the stone; stone may be migrating upward due to frost action); no effervescence.

BA 4 to 10 in. brown (10YR 5/3) (dry) to dark brown (10YR 3/3) (moist), silt loam (same amount of clay but less sand than A horizon); weak, medium-sized plates breaking to fine subangular blocky texture; most of the soil not in peds. 1 to 5 fine roots/sq.in. Small stone within matrix with carbonate coating on bottom; matrix does not react; no effervescence.

Bk1 10 to16 in. pale brown/brown (10YR 5.5/3) (dry) to brown/dark brown (10YR 4/3) (moist), silt loam (about 15 to 17% clay); weak 1/2 in. subangular blocky structure; common fine roots; few 1/4 in. stones with 1/10 mm carbonate rinds on the bottom which easily flake off with fingernail; moderate effervescence.

Bk2 16 to 24 in. light brownish gray (2.5Y 6/2) (dry) to brown/dark brown (10YR 4/3) (moist) silt loam; increasing stone content; fine subangular blocky structure; common medium-sized (1/32 to 1/16 in.) roots; strong effervescence.

Bk3 24 to 28 in. brown/dark brown (10YR 4/3) (moist), stony loam; carbonate coats on stones are greater than 1 mm thick and are crusty and porous; sand grains appear to be incorporated into (engulfed by) the carbonate coats; orange blotches on stone bottoms with depth; strong effervescence.

Auger refused at 28 in.

ESA plot #2. Big Lost River alluvium (Qa deposit).

Classification—Coarse-loamy over loamy-skeletal Typic or Xeric Haplocalcid.

A 0 to 4 in. brown (10YR 5/3) (dry) to very dark grayish brown (10YR 3/2.5) (moist) loam to stony loam; desert pavement ground cover; weak medium platy breaking to very fine granular structure; common medium and fine roots; no effervescence.

BA 4 to 10 in. brown (10YR 5/3) (dry) to dark brown (10YR 3/3) (moist), loam; weak subangular blocky with some platy structure; few fine pores in peds; fewer stones than in surface horizon; few 1/4 in. stones but many of the stones that are present are coated along vertical faces with carbonates. Carbonate coats/crusts on stone bottoms scrape off but not in sheets as at ESA-1; slight effervescence.

Bk1 10 to 16 in. pale brown (10YR 6/3) (dry) to brown/dark brown (10YR 4/3) (moist) stony loam; thin (0.5 mm) rinds on bottom of stones; stones from 1/8 to 1 in. diameter; no orange blotches on stone bottoms. Carbonate covers stone bottoms evenly like frosting, but not chunky like at ESA-1, strong effervescence; abrupt horizon boundary.

Bk2 16 in. + pale brown (10YR 6/3) (dry) to brown/dark brown (10YR 4/3) (moist) stony sandy loam; carbonate coats on stone bottoms, strong effervescence.

Auger refused at 18 in.

ESA Plot #3. Old Channel of the Big Lost River (Qb alluvial deposit).

Located within an old channel of the Big Lost River, presumably a Qb deposit (i.e., younger than the Qa deposits). Ground surface covered by 1/2 in. gravel, which are not oxidized and do not appear to be weathered like the gravel armor of ESA-1 and ESA-2.

Classification—Coarse-loamy over fragmental Typic Torrifluvent.

A 0 to 4 in. grayish brown (10YR 5/2) (dry) to very dark grayish brown/dark grayish brown (10YR 3.5/2), (moist) loam; about 10–12% clay with a very fine sand fraction, 3/4 in. platy crust over weak fine and very fine granular structure and loose soil; slight effervescence.

C1 4 to 12 in. brown/dark brown (10YR 4/3) (dry) to dark grayish brown (10YR 4/2) (moist) sandy loam; soil gets denser with depth due to fewer roots; subangular blocky structure around roots but otherwise structure is ill-defined; slight effervescence.

C2 12 in. + gravel. There are carbonate coatings on bottoms of rocks but they are weak and discontinuous; oranges splotches appear on the wet spots of the rocks. There are 1/8 in. (and finer) sands between the larger stones. Stones appear fresh (clean); some, but not all, have carbonate rinds or clasts on the bottoms; slightly effervescence.

Auger refused at 14 in.

ESA Plot #4. Big Lost River floodplain deposits (Qb deposit).

This profile consisted of layered sandy loams and loamy sands, with some silt loam layers or partial (i.e., discontinuous) layers. Few stones in profile to 60 in., no stones > 1 in. diameter. No stones on soil surface. Soil is effervescent throughout the profile. Coarser textured than the deposits described by Rathburn (1991), and coarser than the deposits exposed in a cut bank exposed by the (modern) Big Lost River channel to the west.

Classification—Coarse-loamy Typic Torriorthent.

A 0 to 10 in. grayish brown (10YR 5/2) (dry) to very dark grayish brown/dark grayish brown (10YR 3.5/2) (moist) fine sandy loam. Common medium roots. Slight effervescence.

C1 10 to 14 in. very dark grayish brown (10YR 3/2) (moist) sand, slight effervescence.

C2 14 to 17 in. very dark grayish brown (10YR 3/2) (moist) silt loam, very dark and silty; platy structure; slight effervescence.

C3 17 to 28 in. very dark grayish brown (10YR 3/2) (moist), sandy loam, moderate effervescence.

C4 28 to 30 in. dark brown (10YR 3/3) (moist), sandy loam, few small (1/4 in.) stones start to appear in profile; moderate effervescence.

C5 30 to 42 in. dark brown (10YR 3/3) (moist) sand; no visible carbonates; moderate effervescence.

C6 42 to 58 in. brown (10YR 5/3) (dry) to dark brown (10YR 3/3) (moist) sandy loam; weak subangular blocky structure with fine plates and brownish yellow (10YR 6/6) mottles inside. Few nodules (wasp or cicada burrows); about 10% small stones; carbonate streaking in few peds; light carbonate coating on stone bottoms; moderate effervescence.

C7 58 to 60 in. pale brown (10YR 6/3) (dry) to brown/dark brown (10YR 4/3) (moist) sandy loam; moderate effervescence.

Abandoned soil boring at 60 in.

ESA Plot #5. Big Lost River deposits (Qb unit).

Classification—Fine-loamy over sandy Typic Torrifluvent.

A1 0 to 0.75 in. light brownish gray (10YR 6/2) (dry) to dark grayish brown (10YR 4/2) (moist) silt loam; platy but not porous structure; a single 3/4 in. plate; slight effervescence.

A2 3/4 to 2.5 in. light brownish gray (10YR 6/2) (dry) to dark grayish brown (10YR 4/2) (moist) silt loam; platy breaks to fine angular blocks or fine platy structure; many fine to very fine pores; moderate effervescence.

C1 2.5 to 7 in. pale brown/brown (10YR 5.5/3) (dry) to grayish brown to dark grayish brown (10YR 3/2.5) (moist) loam (grittier [i.e., more sand, than above]); medium plates (1/8 to 1/4 in. thick); common fine and medium roots; moderate effervescence.

C2 7 to 16 in. grayish brown (10YR 5/2) (dry) to grayish brown/dark grayish brown (10YR 4.5/2) (moist) silt loam; platy (1/8 in. plates); few small (1/4 in.) stones; common fine and medium roots; many fine pores; carbonate streaks and coats through peds; moderate effervescence.

C3 16 to 27 in. gravelly sand, more stones; moderate effervescence.

C4 27 in. + coarse to medium sand; moderate effervescence.

Auger refused at 29 in.

RSA Plots

RSA Plot #1. Pancheri Silt Loam.

A 0 to 6 in. brown/dark brown (10YR 4/3) (moist) silt loam; many fine and medium roots; platy in upper 2 in. grading to moderate medium granular structure; common fine and very fine pores; slight effervescence.

Bk1 6 to 14 in. yellowish brown (10YR 5/4) (dry) to brown/dark brown (10YR 4/3) (moist) silt loam; common fine pores; weak to medium strength, moderate subangular blocky structure; common fine to medium roots (hold peds together); moderate effervescence.

Bk2 14 to 18 in. very pale brown (10YR 7/3) (dry) to brown (10YR 5/3) (moist) silt loam; very few stones (only one found during excavation of this horizon); strong medium subangular blocky structure; cicada nodules; strong effervescence. About 0.5 to 1 mm carbonate coatings on one basaltic stone; coating patchy; carbonate streaks around perimeter of cicada nodules (nodules coated with carbonates).

C 18 to 38 in. very pale brown/light yellowish brown (10YR 6.5/4) (dry) to yellowish brown (10YR 5/4) (moist) silt loam. Weak subangular blocky to loose structure; no roots or stones; some plates around 36 in. and some clayey (finer textured) nodules which are darker; moderate effervescence; some pockets of carbonates and streaking.

C2 38 to 60 in. very pale brown (10YR 7/4) (dry) to pale brown (10YR 6/3) (moist) silt loam; loose to weak subangular blocky structure; reddish yellow (5YR 6/6) staining on some peds. Very pale brown (10YR 7.5/3) (dry)/(10YR 7/3.5) (moist) basaltic grus (granules of iron-rich microcrystalline basalt with crystals of plagioclase feldspar, olivine, and clinopyroxene. More carbonates; moderate effervescence.

C3 60 to 66 in. pale brown (10YR 6/3) (moist) silt loam; pink (5R 8/4 and 5R 7.5/4) stains on top of some peds; porous underneath; streaking though very pale brown (10YR 7/4) matrix; moderate effervescence.

C4 66 in. darker, more grus; abandoned boring.

RSA Plot #2. Polatis Silt Loam.

Soil depth may be greater than described here. Depth measured was based on the assumption that refusal was bedrock, where it may have been one or several stones. Polatis series are typically deeper than the soil described here.

A 0 to 3 in. dark brown (10YR 3/3) (moist) loam; medium moderate granular structure; common medium roots; slight effervescence below 1.5 in.; wavy smooth boundary.

BA 3 to 6 in. brown/dark brown (10YR 4/3) (moist) loam; weak medium subangular blocky structure; common medium roots; slight effervescence; clear smooth boundary.

Bt1 6 to 12 in. light yellowish brown (10YR 6/4) (dry), brown/dark brown (10YR 4.5/ 4) (moist) heavy loam (about 24% clay); medium strong subangular blocky structure; few fine pores; few fine roots; moderate effervescence.

Bt2 12 to 18 in. yellowish brown (10YR 5/4) (dry) to brown/dark brown (10YR 4/3) and yellowish brown (10YR 5/4) (moist) clay loam (about 25 to 28% clay). Gritty and sticky; common fine pores; distinct lines of breakage within peds (with dark lines); strong subangular to angular blocky structure; basaltic grus present; moderate effervescence.

R 18 in. basaltic rock; auger refused.

RSA Plot #3. Polatis Silt Loam.

A 0 to 4 in. dark brown (10YR 3/3) (moist) to dark yellowish brown (10YR 3/4) (moist) silt loam; vesicular plates to 1.5 in.; many fine and medium pores; common medium and fine roots; silt loam moderate medium granular structure from 1.5 to 4 in.; common fine and medium roots; no effervescence.

BA 4 to 10 in. yellowish brown (10YR 5/4) (dry) to dark yellowish brown (10YR 4/4) (moist) silt loam; weak platy and subangular blocky structure (1 in.) breaking to 1/4 in. subangular blocks; common medium and fine roots; no effervescence.

Bk1/C 10 to 20 in. light yellowish brown (10YR 6/4) (dry) to dark yellowish brown (10YR 4/4) (moist), powdery (not much structure); few roots; some hard (firm) 1 in. peds containing streaks and what appears to be clay smearing; microtubules and very fine pores; strong effervescence.

C 20 to 32 in. light yellowish brown (10YR 6/4) (dry) to dark yellowish brown (10YR 4/4) (moist); appears somewhat darker silt loam with some basaltic grus; doesn't appear to be as fine (i.e., clayeyer) textured as **RSA plot 4:** strong effervescence.

R 32 in. basaltic rock; auger refused.

RSA Plot #4. Polatis Silt Loam.

Soil wet to about 8 in. from recent snowfall.

A 0 to 4 in. dark brown (10YR 3.5/3) (moist) silt loam; platy and vesicular cap with many fine pores; spongy looking; no effervescence.

BA 4 to 10 in. yellowish brown (10YR 5/4) (dry), brown/dark brown (10YR 4/3) (moist) silt loam (about 18% clay); weak to moderate subangular blocky structure; peds about 1 in. diameter; few fine to medium sized pores; no effervescence.

Bk1 10 to 14 in. yellowish brown (10YR 5/4) (dry) to dark yellowish brown (10YR 4/4) (moist) silt loam (about 20% clay). Firm subangular to angular blocky structure; some peds contain plates; some nodules are platy inside; i.e., bioturbation evidence, genesis of plates probably deposition inside the caverns. Few fine pores; mottling; slight effervescence: few carbonate streaks through peds; few small (1/8 to 1/4 in.) stones which are coated on the bottom with carbonates.

Bk2 14 to 20 in. light yellowish brown (10YR 6/4) (dry) to brown (10YR 5/3) (moist) silt loam (clay about 23 to 24%); weak to moderate subangular blocks and firm subangular blocks (firm peds are about 1/4 in.); powdery consistence in the auger; strong effervescence.

Bk3 20 to 27 in. pale brown/light yellowish brown (10YR 6/3.5) (dry) to brown (10YR 5/3) (moist) silty clay loam (about 28% clay). Possibly a 2Btk horizon, i.e., paleosol; stiff and chunky; strong subangular to angular blocks; darker color; strong effervescence: pockets of carbonate but the matrix appears to have less carbonate content than above.

R 27 in. basaltic rock; auger refused.

RSA Plot #5. Pancheri Silt Loam.

In a basin area within a basaltic plain, soil is moist to 4 in. from recent snowfall.

A 0 to 4 in. dark brown (10YR 3/3) (moist) silt loam; medium moderate granular structure (no platy/vesicular surface crust); darker color around root channels; common medium roots; no effervescence.

BA 4 to 8 in. dark brown (10YR 4/3.5) (moist) silt loam; medium weak subangular blocky structure, no effervescence.

Bk1 8 to 12 in. pale brown/light yellowish brown (10YR 6/3.5) (dry) to brown/dark brown (10YR 4/3.5) (moist) silt loam; medium firm angular blocky to subangular blocky structure with some plates; organic mat between plates; few small roots and few fine pores; moderate effervescence.

Bk2 (or B/C) 12 to 26 in. very pale brown (10YR 7/4) (dry) to brown (10YR 5/3) (moist) silt loam. Weak structure; powdery with some firm peds; light yellowish brown (10YR 6/4) (darker and drier inside ped); moderate effervescence; weaker peds have carbonates inside; some streaking throughout the matrix; probably a C horizon.

C 26 to 49 in. light yellowish brown (10YR 6/4) (dry) and pale brown/light yellowish brown (10YR 6/3.5) (dry) to brown (10YR 5/3) and brown/dark brown (10YR 4/3) (moist) silt loam; loose, powdery; moderate effervescence: some streaks.

R 49 in. basaltic rock; auger refused.

Appendix D1
Attachment 5

WAG Biological Field Surveys

CONTENTS

TABLES

Appendix D1
Attachment 5

WAG Biological Field Surveys

D1-5-1. INTRODUCTION

Data gaps that must be filled prior to performing the OU 10-04 ecological risk assessment (ERA) have been documented in a technical memorandum (INEL 1996). One gap identified in this memorandum is the need for more complete information regarding the status of threatened or endangered (T/E) and species of concern (formerly designated C2) at the INEEL. This information is required to support the interpretation and characterization of ecological risk that may be predicted by the WAG and OU 10-04 ERAs. To obtain this information, a biological survey of State and Federal T/E and species of concern that may inhabit or frequent contaminated sites and areas within facilities and other areas of the INEEL (as defined by the FFA/CO) has been conducted for WAGs 1, 2, 3, 4, 5, and 9, and will be conducted for WAGs 6, 7, 8, and 10 during implementation of the OU 10-04 WP in FY-99.

The objectives of this survey are to gather site-specific data to replace conservative assumptions and allow quantitative/qualitative evaluation of ERA risk estimates, and to meet the following Federal and State regulatory requirements regarding T/E and species of concern[a]:

- "The Endangered Species Act requires the preparation of a biological assessment if federally endangered or threatened species inhabit or visit the CERCLA site or are located in areas adjacent to the site likely to be impacted by hazardous substances released at the site. Candidate species (C2 designation) for federal listing should also be evaluated for inclusion in the biological assessment."

- "The draft biological assessment must be submitted to the appropriate regional office of the (Fish and Wildlife Service) FWS for review"..."After review of the draft biological assessment, the FWS determines whether formal consultation is necessary." (i.e. under Section 7 of the ESA the FWS may request revisions to the draft assessment for submittal as a formal report).

- "The FWS will prepare a *biological opinion....*" "The biological opinion will conclude that the project will or will not lead to further decline of the species..."

The biological assessment is as quantitative as possible (given scheduling and budget constraints) and follows prescribed protocols to meet the scrutiny of trustees and FWS with regard to presence of species and/or suitable habitat and interpretation of any calculated ecological risk.

Information gathered is intended to support an evaluation (scientific and empirical data supported by professional judgement) of (1) presence or absence of T/E and C2 species at or in close proximity to the WAGs, (2) the likelihood for exposure to contaminated areas, and (3) risk to species individuals and populations shown by an ERA. Species specifically addressed by the survey are listed on Table D1-5-1.

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a. Excerpts from DOE Office of Environmental Guidance (June 1994) "Incorporating Ecological Risk Assessment into Remedial Investigation/Feasibility Study Work Plans"(Pages II-57 through II-62).

Table D1-5-1. T/E and species of concern[a] included in the biological survey.[b]

Birds:

- Bald eagle (Federal LT)[c]
- Peregrine falcon (Federal LE)[c]
- Trumpeter swan (FWS and state species of concern)
- Black tern (FWS species of concern)
- White-faced ibis (FWS species of concern)
- Ferruginous hawk (FWS and state species of concern)
- Northern goshawk (FWS and state species of concern)
- Loggerhead shrike (FWS and state species of concern)
- Burrowing owl (FWS and state species of concern)

Mammals:

- Pygmy rabbit (FWS and state species of concern)
- Gray wolf (Federal LE; XN)[c]
- Merriam's shrew (state species of concern)
- Townsend's western big-eared bat (FWS and state species of concern)
- Long-eared myotis (FWS species of concern)
- Small-footed myotis (FWS species of concern)

Reptiles:

- Northern sagebrush lizard (FWS species of concern)

Plants:

- Lemhi milkvetch (state species of concern)
- Plains milkvetch (state species of concern)
- Winged-seed evening primrose (state species of concern)
- Spreading gilia (state species of concern)

a. The U.S. Fish and Wildlife Service (USFWS) no longer maintains a candidate (C2) species listing but addresses former listed species as "species of concern" (USFWS April 30, 1996). The designation "species of concern" is also applied by state agencies.

b. This list was compiled from the USFWS (letter dated July 16, 1997) the Idaho Department of Fish and Game Conservation Data Center threatened, endangered, and sensitive species for the State of Idaho (CDC 1994 and IDFG web site 1997) and RESL documentation for the INEEL (Reynolds et al. 1986).

c. Status Codes: LE = listed endangered; LT = listed threatened; XN = experimental population, non-essential.

D1-5-2. BIOLOGICAL FIELD SURVEY METHODS

In 1996, biological field surveys were conducted in the ***areas surrounding*** WAG facilities (not inside WAG boundaries) to assess the presence and use of those areas by T/E species or other species of concern (i.e., species formerly designated as C2). Those species are listed in Table D1-5-1. The surveys were performed by the Environmental Science and Research Foundation and findings for WAGs 1, 2, 3, 4, 5, 6, 7, and 9 have been documented in a report that includes (a) survey protocols, (b) results for individual WAGs, and (c) an interpretive summary for the ERA conducted as part of the OU 10-04 investigation (Morris 1998). Specific information collected and reported includes:

- Date and conditions under which the surveys were conducted
- Area encompassed by the surveys (Global Positioning System [GPS] mapping where practical)
- GPS locations for observed habitat, sign, and species sighted (where practicable)
- Habitat description, the proximity to WAG or site, and an estimate of whether contaminated sites or areas are within the home range of members of the species in question
- Species presence, abundance, current site use, past site use (historical sightings or surveys), and anticipated site use (professional judgement)
- An estimated site or area population (where possible)
- Surveys for some species were also supported by Geographic Information System (GIS) analyses using recently developed habitat models and existing long term data sets (i.e., Breeding Bird Survey [BBS] data).

On July 31 and August 20, 1997, field surveys were conducted for ***individual sites of concern*** within WAG facilities that have been or are currently being evaluated as part the WAG ERAs. An onsite inspection was conducted and each site of contamination was evaluated for habitat qualities and potential to support INEEL T/E species or other species of concern. A suite of site habitat attributes was evaluated with regard to suitability for each species. The attributes evaluated included:

- Size
- Substrate (gravel, asphalt, lawn, etc.)
- Natural or manmade features that entice wildlife (water, lights, etc.)
- Proximity to areas or sites of facility activity
- Presence and availability of food or prey
- Availability of nesting, roosting, or resting habitat
- Signs of wildlife use

- Prior history, known sightings, or use.

Attributes were subjectively rated for positive contribution to overall habitat suitability. A rating of high, medium, low, or none (indicated by a blank cell) was assigned based on the number of positive habitat features and probability that the species of concern may or does use the site. The convention upon which ratings were assigned for individual habitat attributes are summarized on Table D1-5-2. Although T/E and species of concern were of primary consideration, potential use by game species and unique populations (i.e., spadefoot toad, Merriam's shrew) was also assessed. Some sites rated overall as "low" are those having one or two positive attributes and therefore potential for incidental use by wildlife. These sites may generally be discounted as contributing significantly to chronic exposures to COPCs by wildlife. The duration and stringency of these surveys was not adequate to verify presence or frequency of species occurrence. These surveys were conducted to provide information to allow evaluation of WAG sites of concern in an ecological context. It should be noted that these ratings are subjective, based on professional opinion supported by limited observation.

Surveys of sites of concern and surrounding areas have been completed for WAGs 1, 2, 3, 4, 5, and 9. Survey results for those WAGs are presented in the following sections and are summarized for sensitive species in Table D1-5-3. Surveys for WAGs 6, 7, 8, and 10 will be conducted in FY-99 during implementation of the work plan for WAGs 6 and 10 OU 10-04 Comprehensive RI/FS (hereafter referred to as the work plan). A summary of the remaining biological survey data gaps is presented in Appendix C2.

Table D1-5-2. Habitat rating conventions for WAG sites of concern.

Attribute	Examples
Size	Areas having physical dimensions too small to support species of interest were rated "none" unless enhanced by other attributes. Large, unconfined areas adequate to support wildlife were assigned higher ratings.
Substrate	Asphalt = none, gravel =low, lawn, soil = medium-high for some species, disturbed vegetation community = medium to high, natural vegetation community = high.
Natural or manmade features	Water = high (water [permanent or ephemeral] is an important component in desert systems); lights = medium (both attract insects and consequently bats and insectivorous birds [i.e., swallows, nighthawks])
Proximity to areas of activity	Proximity to areas or sites of moderate or heavy activity may reduce desirability. Sites associated with buildings and facilities may be more suitable if abandoned or little used.
Nesting, roosting, or loafing habitat	Structures such as fence and power poles adjacent to open fields afford perches for roosting and hunting etc.
Signs of wildlife use	Signs of wildlife use are considerations that qualitatively feed the evaluation. Examples of these signs include observation of animal tracks, hair, or scat.
Prior history	Documented or reported sightings.

Table D1-5-3. Summary of sensitive species surveys for WAGs 1, 2, 3, 4, 5, and 9.

	WAG 1 7 sites	WAG 2 16 sites	WAG 3 30 sites	WAG 4 12 sites	WAG 5 16 sites	WAG 9 12 sites
Black tern	●					●
Trumpeter swan						●
White-faced ibis	■					●
Burrowing owl	▼	■	●	●	▼	●
Ferruginous hawk	◆	■	●	■	▼	●
Peregrine falcon	●	■	●	■	▼	●
Loggerhead shrike	◆	■	●	■	▼	●
Bald eagle	▼	●		●	▼	
Bats	▼	◆	●	■	▼	■
Merriam's shrew	●			●	●	■
Pygmy rabbit			●	●	■	●
Sagebrush lizard	▲	■	●	■	◆	■
Spadefoot toad	●	●				●
Game species	◆	■	●	■	◆	■

● > 0% to ≤ 25% of the sites have at least one positive habitat attribute.

■ > 25% to ≤ 50% of the sites have at least one positive habitat attribute.

▼ > 50% to ≤ 75% of the sites have at least one positive habitat attribute.

● > 75% to ≤ 100% of the sites have at least one positive habitat attribute.

▲ 100% of the sites have at least one positive habitat attribute.

D1-5-3. BIOLOGICAL FIELD SURVEY RESULTS FOR WAGS

D1-5-3.1 WAG 1 Survey Results

A survey of the WAG 1 ecological sites of concern was conducted in August 1997. The results of the survey are summarized in Table D1-5-4. Interpretation of high, medium, and low ratings is further explained in Section 2, Table D1-5-2.

Table D1-5-4. Summary of T/E and species of concern survey for WAG 1 habitat.

WAG 1 Site #	B. Tern	T. Swan	W.f. Ibis	B. Owl	F. Hawk	P. Falcon	L. Shrike	B. Eagle	Bats	M. Shrew	P. Rabbit	S. B. Lizard	S. toad	Game species	Comments
TSF-03				M	L	L	L	L	L			L		M	Open crested wheatgrass planting, weeds, no shrubs
TSF-07	H		H	M	M	M	M	M	H	H		M		H	Standing water, cattails, thistle, sagebrush areas, open fencing, roosts near cattails, mud source, swallows, nighthawk, dove sighted
TSF-08				M	M	M	M	M	M			M		H	Unfenced, between road and railroad, adjacent power lines, low shrubs and mustard
LOFT-02				L	M	M	M					M	L	M	Former pond, intermittent water, open fencing, roosts, lush weeds, waterfowl use observed, isolated from active sites
WRRTF-01				M	H	H	L	H				M		H	Crested wheatgrass planting, rabbitbrush, unfenced, adjacent powerline, low activity, frequented by antelope
WRRTF-03			L		M	M	M	M	H	H		H		H	Unfenced 3 pond complex, east area dry, piped facility drainage to central area - cattails, thistles, bare soil berm sparse halogeton, perches adjacent to south, borders natural communities, isolated from activity
WRRTF-13									L			L			Paved area, weedy, adjacent poles and lights, old equipment , isolated from activity

H = High
M = Medium
L = Low

D1-5-3.2 WAG 2 Survey Results

A survey of WAG 2 ecological sites of concern was conducted in August 1997. Results of the survey are shown in Table D1-5-5. Interpretation of high, medium, and low ratings is further explained in Section 2, Table D1-5-2.

Table D1-5-5. Summary of sensitive species survey at WAG 2 completed on 7/31/97.

WAG 2 Site #	B. Tern	T. Swan	W.f. Ibis	B. Owl	F. Hawk	P. Falcon	L. Shrike	B. Eagle	Bats	M. Shrew	P. Rabbit	S. B. Lizard	S. toad	Game species	Comments
TRA-02				L	L	L	L		L			L	L	L	Terminus of ditch - borrow pit adjacent to paved road, low cover, gravel substrate, intermittent water
TRA-03				M	M	M	M	L	L			M		H	Crested wheatgrass planting, nondifferentiated soil cover, small burrows, fence and power pole perches
TRA-04/05				L	L	L	L		L			L			Gravel substrate, open area, sparse kochia, adjacent power poles and structures
TRA-06				L	L	L	L		M	L		M		L	Chem. pond, fairly deep, gravel berm, intermittent water, shrubs and grasses in bottom, adjacent lighting
TRA-08				M	M	M	M		L	L		M	L	H	Shallow pond with shrub cover, intermittent water, adjacent perches, forage, substandard fencing
TRA-13				L	M	M	M	L	L			M			Shallow ditch with gravel substrate, weed and shrubs, 2-strand wire fence, adjacent native community
TRA-15									L			L			Sparse vegetation, large mesh fence, some cover, adjacent lighting and pole perches
TRA-16															Asphalt adjacent to building
TRA-19									L						Gravel area between buildings, weedy annuals and cheatgrass, remediation planned
TRA-34				L	L	L	L	L	L			L		M	North storage area large unfenced revegetated area, primarily weeds, adjacent pole perches and lighting
TRA-36									L						Gravel substrate, sparse vegetation, adjacent lighting, intermittent water, mud
TRA-38									M						ATR cooling towers, roosting structures, adjacent lighting, gravel weed substrate
TRA-619									L						Transformer, gravel pad, adjacent lighting, roosting structures
TRA-626									L						Small spill near building, gravel substrate and weeds surrounded by asphalt, adjacent lighting
TRA-653									L						Transformer, gravel substrate, sparse weeds, adjacent lighting on building walls, next to high bay door
Brass cap															Concrete adjacent to building

H = High
M = Medium
L = Low

D1-5-3.3 WAG 3 Survey Results

A survey of WAG 3 ecological sites of concern was conducted in August 1997. Results of the survey are shown in Table D1-5-6. Interpretation of high, medium, and low ratings is further explained in Section 2, Table D1-5-2.

Table D1-5-6. Summary of sensitive species survey at WAG 3 completed on 7/31/97.

WAG 3 Site #	B. Tern	T. Swan	W.f. Ibis	B. Owl	F. Hawk	P. Falcon	L. Shrike	B. Eagle	Bats	M. Shrew	P. Rabbit	S. B. Lizard	S. toad	Game species	Comments
CPP-06															Gravel substrate
CPP 13															Gravel berm, remedial action completed◊swallows in area
CPP-14															Gravel substrate, former sewage lagoon◊remedial action complete, no
CPP-19															Gravel and asphalt substrate, higher levels below surface, no vegetation◊subsurface soil
CPP-22				L	L	L	L					M		L	Air release to areas south outside fence, sagebrush and weeds, gravel substrate inside fences
CPP-34					L	L	L		L					L	Weed cover, gravel substrate, adjacent power poles/lighting, adjacent to sewage disposal ponds
CPP-37A					L	L	L								Outside fence, weedy annuals
CPP-37B									L						Ditch with significant, periodic water, weedy annuals
CPP-39															Gravel and asphalt substrate, remedial action
CPP-40															Gravel berm, remedial action completed
CPP-42															Shallow ditch, gravel substrate, sparse weeds (Russian thistle), intermittent water
CPP-44															Gravel substrate
CPP-46															Gravel substrate
CPP-48															Gravel substrate, remedial action completed, sparse weeds (Russian thistle)
CPP-54															Gravel substrate, sparse weeds (Kochia)
CPP-55															Gravel substrate, sparse weeds (Russian thistle)
CPP-56															Gravel substrate, removal action in progress, adjacent buildings/structures
CPP-59 (2)															Gravel berms, sparse weeds (Kochia and Russian thistle)
CPP-61															Gravel substrate
CPP-65									H					H	Sewage lagoons, permanent water, lights, observed wildlife use
CPP-66															Gravel and asphalt substrates

Table D1-5-6. (continued).

WAG 3 Site #	B. Tern	T. Swan	W.f. Ibis	B. Owl	F. Hawk	P. Falcon	L. Shrike	B. Eagle	Bats	M. Shrew	P. Rabbit	S. B. Lizard	S. toad	Game species	Comments
CPP-78															Tiny area, gravel substrate and asphalt, no vegetation
CPP-84															Beneath existing building
CPP-86															Below ground, remediation in progress
CPP-87															Gravel substrate, adjacent roosting structures
CPP-88															Large general areas of contaminated soil inside fences
CPP-90															Gravel substrate, remedial action complete, adjacent roosting, little potential for exposures
CPP-93															Gravel berm
Percolation ponds															
Tank farm															
10-06 sites assessed separately															

H = High
M = Medium
L = Low

D1-5-3.4 WAG 4 Survey Results

A survey of WAG 4 sites of concern was conducted in August 1997. The survey results are presented in Table D1-5-7. Interpretation of high, medium, and low ratings is further explained in Section 2, Table D1-5-2.

Table D1-5-7. Summary of sensitive species survey at WAG 4 completed on 8/20/97.

WAG 4 Site #	B. Tern	T. Swan	W.f. Ibis	B. Owl	F. Hawk	P. Falcon	L. Shrike	B. Eagle	Bats	M. Shrew	P. Rabbit	S. B. Lizard	S. toad	Game species	Comments
CFA-01				H	H	H	M	M	L			H		M	Landfills, crested wheatgrass plantings, power lines, and fence perching
CFA-02															
CFA-03															
CFA-04				H	H	H	H	M	M		M	H		H	Unfenced, ephemeral water, native and planted communities, good perches, low activity
CFA-05				M	L	L	L		L	L	L	H		M	Unfenced, native community, gravel substrate, intermittent water, adjacent powerlines
CFA-10					L	L	L		L			M		L	Small area, gravel substrate, open gates, weedy and good cover for small mammals
CFA-12														L	Adjacent to building wall, landscaped bed, adjacent lawn, removal action, rabbits, killdeer, mule deer
CFA-26															Asphalt adjacent to railroad tracks, building overlies site
CFA-40												L			Gravel substrate, open wire fencing, adjacent to warehouse, excessed equipment, small animal cover
CFA-41												L			Gravel substrate, open wire fencing, adjacent to warehouse, excessed equipment, small animal cover
CFA-43															Lead storage area
CFA –50															Gravel substrate, adjacent to railroad tracks, shallow well, removal action, elevated metals

H = High
M = Medium
L = Low

D1-5-3.5 WAG 5 Survey Results

A survey of WAG 5 ecological sites of concern was conducted in August 1997. The results of the survey are presented in Table D1-5-8. Interpretation of high, medium, and low ratings is further explained in Section 2, Table D1-5-2.

Table D1-5-8. Summary of sensitive species survey at WAG 5.

WAG 5 Site #	B. Tern	T. Swan	W.f. Ibis	B. Owl	F. Hawk	P. Falcon	L. Shrike	B. Eagle	Bats	M. Shrew	P. Rabbit	S. B. Lizard	S. toad	Game species	Comments
ARA-01				M	M	M	H	L	L			H		H	Leach pond complex, open wire fences, crested wheatgrass and shrubs, posts, adjacent native vegetation
ARA-02				M	M	M	H	L	L			H		H	Leach pond complex, open wire fences, crested wheatgrass and shrubs, posts, adjacent native vegetation
ARA-03				M	M	M	H	L	L			H		H	Leach pond complex, open wire fences, crested wheatgrass and shrubs, posts, adjacent native vegetation
ARA-06				M	M	M	M	M	L			H			SL1, ROD signed, fenced site, large basalt rip-rap surrounded by revegetation, fenced
ARA-10				L	L	L	L		L					L	Fenced area inside chainlink/cyclone, power poles, weeds, gravel substrate
ARA-12				H	H	H	H	M	M	L	L	H		H	Unfenced area in depression, junipers, willows, good cover, intermittent water, shrike use, basalt cover
ARA-16												M		L	Buried tank, weedy area surrounding shallow hole, collects water, signs of animal use, fenced w/openings
ARA-23				H	H	H	H	H	H		M	H		H	200 acre windblown, native shrub/grass communities, see isopleths
ARA-24				H	H	H	H	H	H		M	H		H	Plume areas—see isopleths
PBF-04															Gravel substrate inside substation containment fence, native sagebrush community surrounding
PBF-10														M	Unfenced, revegetated with native grasses and forbs
PBF-16				H	H	H	H	M				H			Juniper, tall sagebrush, shallow depression, roosting/nesting, small mammal sign
PBF-20									M					M	Bermed depression containing grasses and annuals, intermittent water, adjacent roost sites, unfenced
PBF-21				M	M	M	M	M	M		M	H		H	Large open area of native revegetation bordered by native sagebrush community
PBF-22				H	H	H	H	M	M		L	H		H	Tall sagebrush, grasses, rabbitbrush, deep ditch
PBF-26				H	H	H	H	M	M		L	H		H	Low area next to 22, crested wheatgrass planting, adjacent tall sagebrush, basalt outcrops, power poles

H = High
M = Medium
L = Low

D1-5-3.6 WAG 7 Survey Results

A survey of WAG 7 will be conducted in FY-99. The results of this survey will be incorporated into the appropriate documentation when available.

D1-5-3.7 WAG 8 Survey Results

A survey of WAG 8 will be conducted in FY-99. The results of this survey will be incorporated into the appropriate documentation when available.

D1-5-3.8 WAG 9 Survey Results

A survey of WAG 9 sites of concern was conducted in August 1997. Results of the survey are shown in Table D1-5-9. Interpretation of high, medium, and low ratings is further explained in Section 2, Table D1-5-2.

Table D1-5-9. Summary of sensitive species survey at WAG 9.

WAG 9 Site #	B. Tern	T. Swan	W.f. Ibis	B. Owl	F. Hawk	P. Falcon	L. Shrike	B. Eagle	Bats	M. Shrew	P. Rabbit	S. B. Lizard	S. toad	Game species	Comments
ANL-01[a]	H	M	H						H	H		L	H	H	Industrial waste pond, periodic standing water, cattails, unfenced, waterfowl, big game, other wildlife use documented
ANL-01A[a]									M	H		L			Cooling tower ditch, periodic water source, cattails, doves, killdeer nest, swallows, rushes, fenced, weed control, gravel substrate, potential bat roosting in cooling towers, adjacent lighting
ANL-01 ditch A															Ditch section from auxiliary cooling tower and intermittent surface water runoff. Gravel substrate
ANL-01 ditch B[a]										M					Ditch section, periodic water up to 10 gal/minute, grassland to fence, cattails, cheatgrass
ANL-01 ditch C										L		L			Short above ground ditch section transitions to belowground, heavy weed areas, small amounts of water, gravel substrate
ANL-04[a]	H	M	H						H				M		Sewage lagoons, waterfowl, swallows, butterflies, nighthawk, algae, sparse shore vegetation
ANL-05				H	H	H	H				M	H		H	Burn pits, outside fences, sagebrush/basalt, patches of basin wildrye, adjacent to large areas of natural vegetation, poles for perches
ANL-09									M		L	M		L	Interceptor canal, outside fence, sparse vegetation/weeds on banks
ANL-29									L						Lift station, gravel substrate, perching structures, lighting
ANL-35[a]									M						Lifts station discharge ditch, running water, cattails
ANL-36												L		L	Photo lab ditch drifted in with silt from 1994 burn area, sparse vegetation, no water
ANL-61A															PCB spill, gravel substrate adjacent building
ANL-62															Boiler building hotwell, gravel substrate, 7-ft deep, enclosed

a. ANL-01, ANL-01A, ANL-01B, ANL-04 and ANL-35 will be remediated under the WAG 9 ROD.

H = High
M = Medium
L = Low

D1-5-3.9 WAG 6 and 10 Survey Results

Surveys for WAG 6 and WAG 10 are scheduled for completion in FY-99. Results of these surveys will be presented in the OU 10-04 ERA. Any additional screening or changes resulting from the comparison will be presented in the OU 10-04 R1/BRA.

D1-5-4. REFERENCES

Arthur, W. J., J. W. Connelly, D. K. Halford and T. D. Reynolds, 1984, *Vertebrates of the Idaho National Engineering Laboratory, Idaho Falls, ID*, DOE/ID-12099, U.S. Department of Energy, Idaho Operations Office, 40 p.

CDC, 1994, *Rare, Threatened, and Endangered Plants and Animals of Idaho*, 3rd edition, State of Idaho Department of Fish and Game, Conservation Data Center, 39 p.

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Morris, R. C., 1998, *Potential Use of Habitats Within and Surrounding Facilities at the Idaho National Engineering and Environmental Laboratory by Sensitive Species: A Biological Assessment*, ESRF-026, Environmental Science and Research Foundation, Idaho Falls, ID, 61 p.

Reynolds, et al., 1986 "Vertebrate Fauna of the Idaho National Environmental Research Park," *Great Basin Naturalist*, Vol. 26, pp. 513–527.

FWS, 1996, Snake River Basin Office, Letter to T. D. Reynolds, "Amended List of Threatened, Endangered, Candidate/Proposed Species for INEEL."

Appendix D1
Attachment 6

Preliminary Evaluation of Available FY-97 Ecological Sampling Analytical Results

Appendix D1
Attachment 6

Preliminary Summary of FY-97 Ecological Sampling Analytical Results

D1-6-1. INTRODUCTION

This is a summary of sample data collected in the summer of 1997 to support the OU 10-04 ERA at the INEEL (DIE ID 1997). Samples of both biotic and abiotic material were obtained. The abiotic material consisted of surface soil from the INTEC (formerly CPP) plume area, and both sediment and water from the ANL-W industrial waste pond. For convenience we will refer to the INTEC plume area and ANL-W industrial waste pond as "on-Site" locations. Samples of surface soil were also obtained from an off-Site area.

Biotic samples were obtained from the INTEC plume and off-Site areas for a selection of animal and plant species. The two types of mammals, rabbits (*Sylvilagus nuttallii*) and deer mice (*Peromyscus maniculatus*); two types of insects, beetles (*Eleodes* spp.) and grasshoppers (Family Acrididae); and two types of plants sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and wheatgrass (*Agropyron cristatum*) were sampled. These samples were analyzed for a wide range of contaminants, both metallic and radiological, and the data were recorded in the Environmental Restoration Information System (ERIS) system.

The abiotic metals and radiological data included in this summary have been validated, but a large portion of the biotic data set was not available at the time of this summary. The completed data set will be included in the OU 10-04 ERA. Furthermore, the biotic data had not yet received final validation. The laboratory analysis of the mammal data has not been completed; the laboratory analyses for radiological contaminants of the insect and plant samples had been completed, but the results were not uploaded to the ERIS.

For data that are presently available for analysis and summarization, some concentrations were designated as less-than-detectable (U flagged) amounts. For the purpose of evaluating the biological uptake, the measurements identified as U flags were treated as missing data and excluded from the analysis. It should be noted that treating nondetects as missing data generally leads to results that are higher than they would be if the actual measurements were available. For example, values below the detection limit would tend to lower the estimate of the mean value if they could be included. Since these data were collected for other purposes than risk assessment, ½ the minimum detection limit (MDL) is not appropriate to use.

This preliminary summary includes only the mean, minimum, maximum, range, and standard deviation of those samples available and considered appropriate to use. The final evaluation of this data will be performed as part of the OU 10-04 ERA effort. At this time the negative activities will be included in the analysis if appropriate. For radionuclides, it is common to use all the data, including activities below detection limit and negative activities, to calculate distributional parameters such as mean and standard deviation. Information about the analytical method employed is necessary to understand these data and will also be included in the final evaluation.

D1-6-2. RESULTS

Laboratory and validation flags on the inorganic sample results need to be evaluated prior to use in the assessment. Descriptions of laboratory flags for the inorganic analysis are as follows:

C (Concentration) qualifier ♦ Specified entries and their meanings are as follows:

B ♦ The reported value was obtained from a reading that was less than the contract required detection limit (CRDL) but greater than or equal to the instrument detection limit (IDL).

U ♦ The analyte was analyzed for and was not detected.

Q qualifier ♦ Specified entries and their meanings are as follows:

E ♦ The reported value is estimated because of the presence of interference. An explanatory note shall be included under Comments on the Cover Page (if the problem applies to all samples) or on the specific inorganic analysis data sheet (if it is an isolated problem).

M ♦ Duplicate injection precision was not met.

N ♦ Spiked sample recovery was not within the control limits.

S ♦ The reported value was determined by the method of standard additions (MSA).

W ♦ Post-digestion spike for GFAAS analysis is out of the control limits (85-115%), while sample absorbance is less than 50% of spike absorbance.

* ♦ Duplicate analysis was not within the control limits.

+ ♦ Correlation coefficient for the MSA is less than 0.995.

Entering "S", "W", or "+" is mutually exclusive. No combination of these qualifiers can appear in the same field for an analyte.

Description of validation flags for inorganic analysis are as follows:

U ♦ The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit. In most instances, a "U" validation flag will be accompanied by a "B" laboratory flag.

UJ ♦ The material was analyzed for, but was not detected. The associated value is an estimate and may not accurately reflect the IDL in the sample matrix.

J ♦ The analyte was analyzed for and was positively identified, but the associated numerical value may not be consistent with the amount actually present in the environmental sample.

R ♦ The accuracy of the data is so questionable that it is recommended the data not be used.

The following are definitions of the data qualifier flags applied to radiological analysis results.

- U – Analysis was performed and the result is below two times the associated uncertainty for the analysis. The analyte of interest is not considered to be present at the 95% confidence level.
- J – Analysis was performed and a true positive result was obtained (result is greater than two times the associated uncertainty), but the result is considered to be an estimated quantity due to quality control problems. The analyte of interest is considered to be present at the 95% confidence level.
- UJ – The analysis result obtained is below two times the associated uncertainty for the analysis and is considered to be an estimated quantity due to quality control problems. Analyte of interest may or may not be present at the 95% confidence level.
- R – The analysis result obtained is unusable due to major problems with the sample analysis or the supporting quality control information.
- N/A – The indicated analysis was not performed on this sample.

The following definitions are for the validation flags that are applied to the individual validation parameters evaluated during the radiological data validation process.

- I – Parameter is in control, there are no problems with the sample results data.
- Q – Parameter is questionable, there may be minor problems with the sample results data.
- O – Parameter is out of control, there may be major problems with the sample results data.
- N/A – Parameter is not applicable to the analysis type being validated.

A graphical representation of mean concentrations of metallic contaminants in surface soil is provided in Figure D1-6-1.

From Figure D1-6-1 it appears that the largest concentrations are calcium, iron, aluminum, magnesium, potassium and sodium. The differences in concentration between on-Site and off-Site locations will be considered in greater detail in subsequent sections.

Figures D1-6-2 through D1-6-5 provide graphical summaries of the concentrations of metallic contaminants in the biotic samples.

It appears from Figure D1-6-2 that the largest concentrations for beetle samples are aluminum, zinc, and manganese.

It appears from Figure D1-6-3 that the largest concentrations for grasshopper samples are aluminum, zinc, and copper.

It appears from Figure D1-6-4 that the largest concentrations for sagebrush samples are aluminum, boron, manganese, zinc, strontium, copper, and barium.

It appears from Figure D1-6-5 that the largest concentrations for wheatgrass samples are aluminum, manganese, barium, zinc, strontium, boron, and chromium.

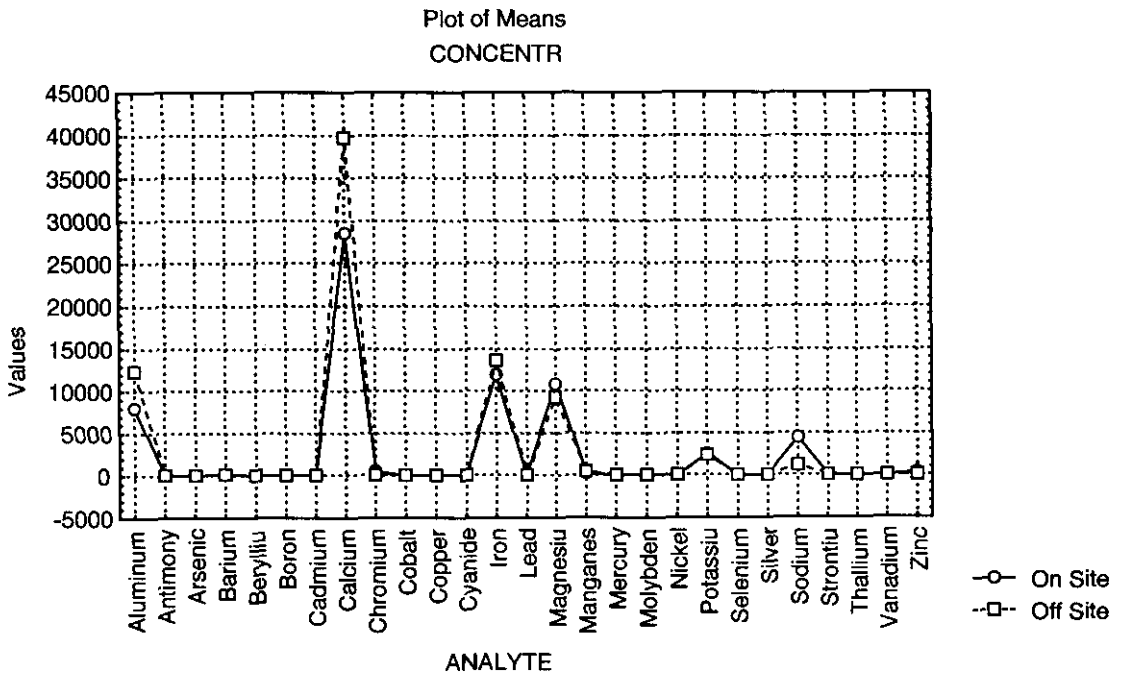


Figure D1-6-1. Mean concentrations of metals in surface soil samples (mg/kg).

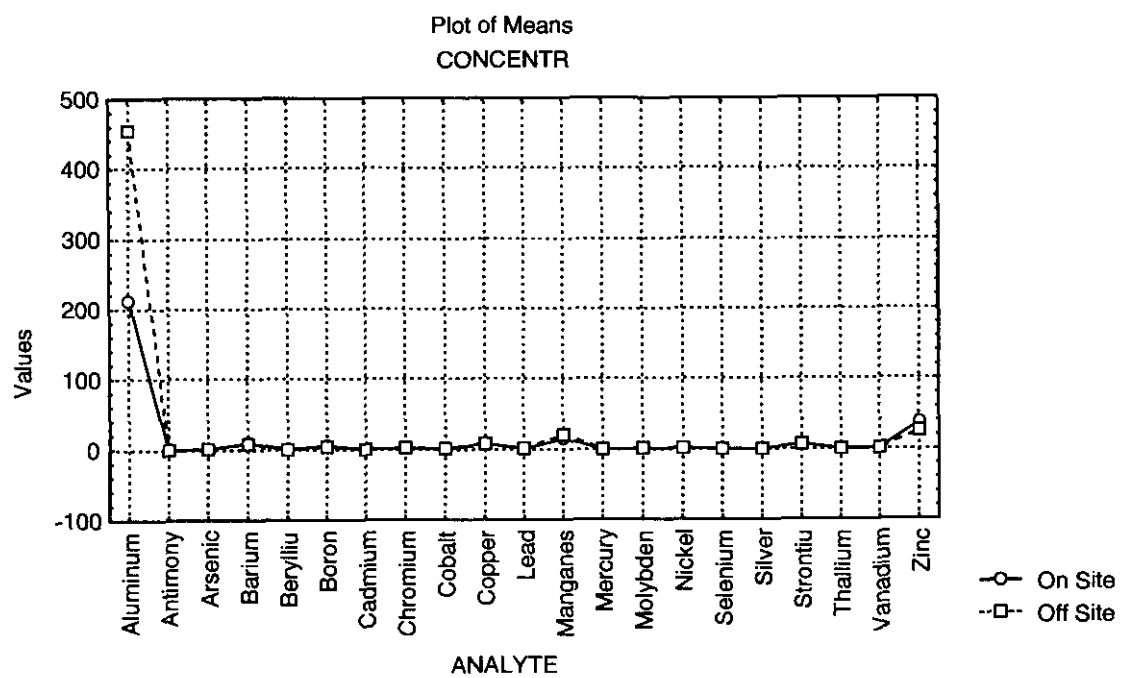


Figure D1-6-2. Mean concentrations of metals in beetle tissue samples (mg/kg).

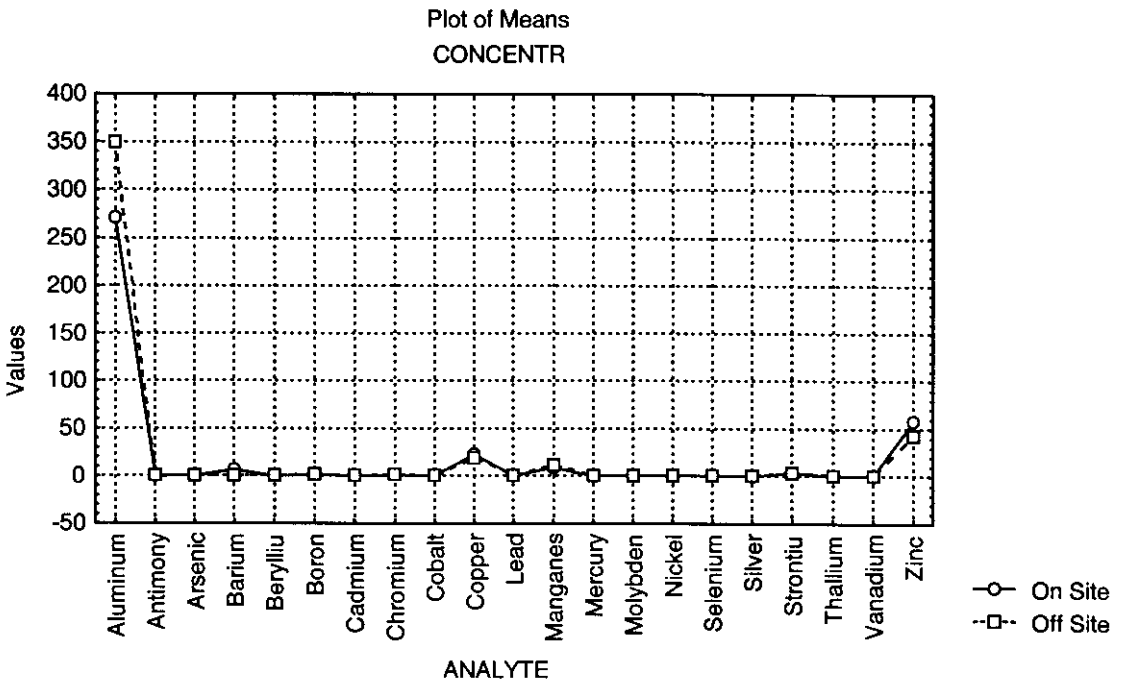


Figure D1-6-3. Mean concentrations of metals in grasshopper tissue samples (mg/kg).

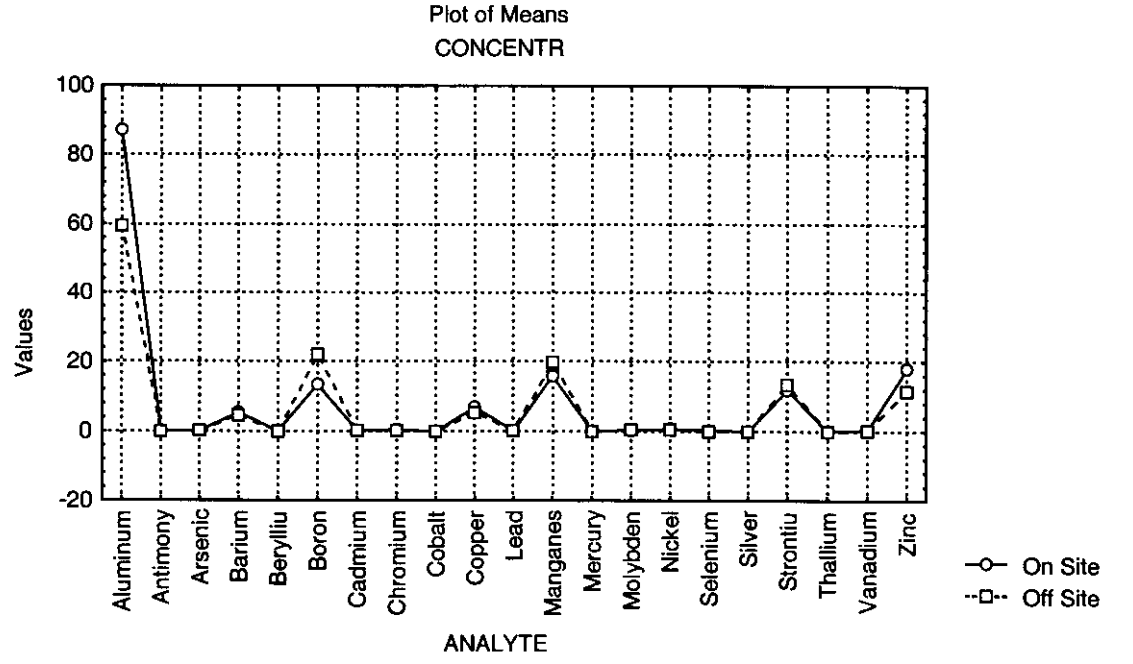


Figure D1-6-4. Mean concentrations of metals in sagebrush tissue samples (mg/kg).

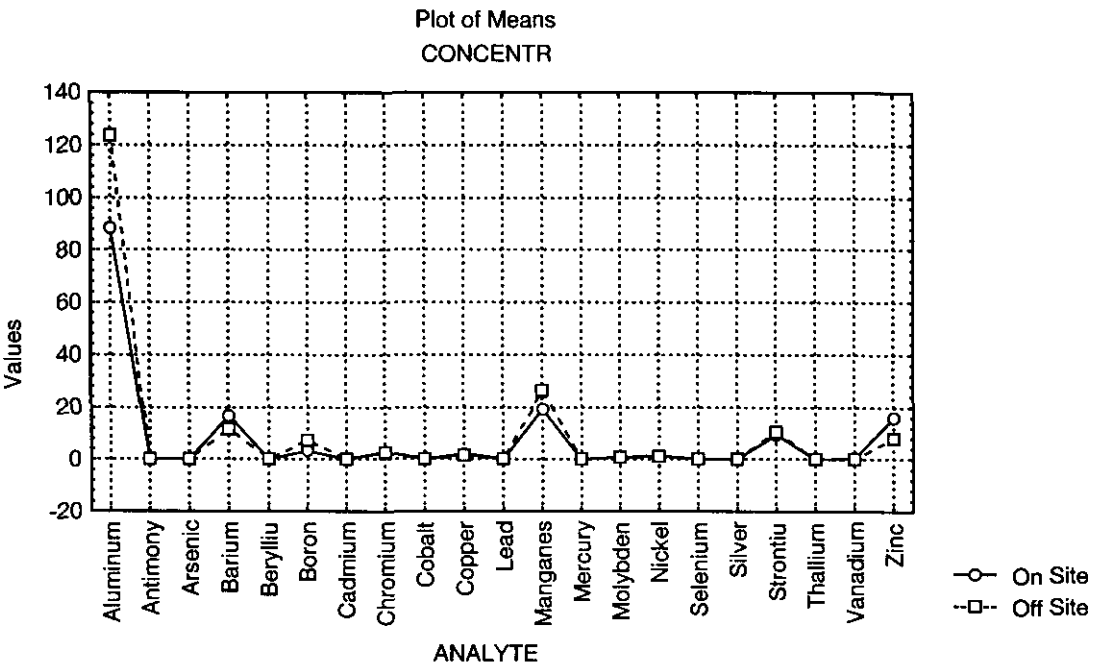


Figure D1-6-5. Mean concentrations of metals in wheatgrass tissue samples (mg/kg).

A graphical representation of mean concentrations of metallic contaminants for waste pond sediment and water samples is provided in Figure D1-6-6.

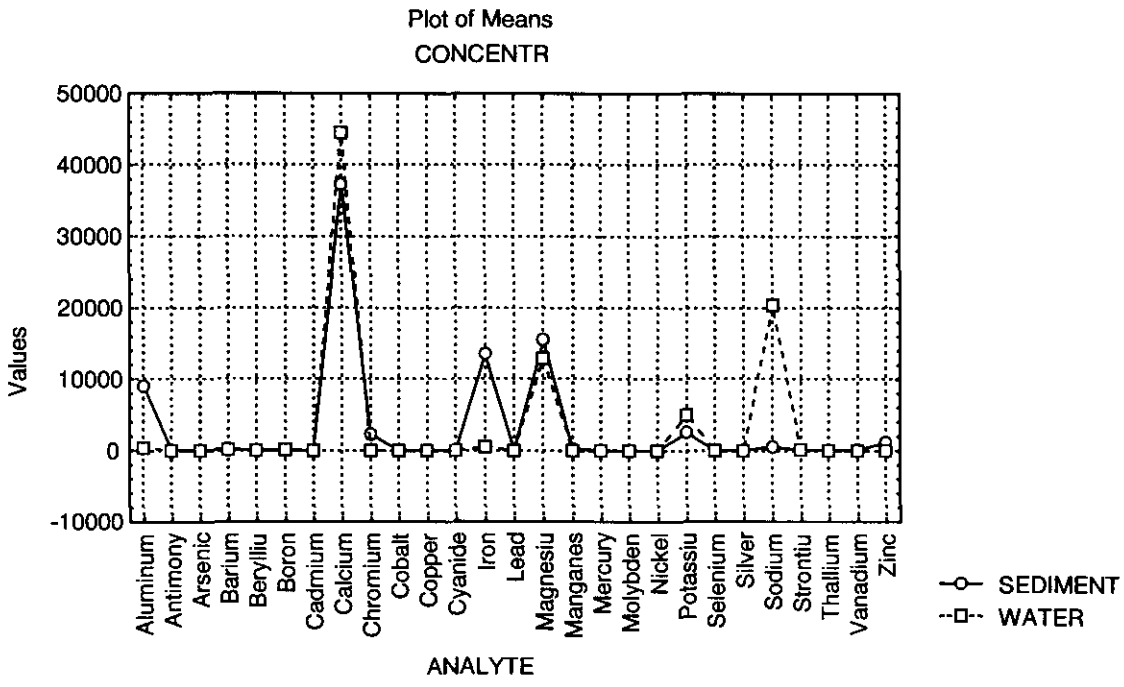
It appears from Figure D1-6-6 that the largest concentrations for sediment samples are calcium, magnesium, iron, aluminum, potassium, chromium, and zinc. The largest concentrations for water samples appear to be calcium, sodium, magnesium, and potassium.

Figures D1-6-7 and D1-6-8 provide graphical summaries of the concentrations of radiological contaminants in the abiotic samples.

It appears from Figure D1-6-7 that the largest concentrations in surface soil are U-234, U-238, Cs-137, and Sr-90.

It appears from Figure D1-6-8 that the largest concentrations in sediment are beta, Cs-137, U-234, and U-238. The largest concentrations for water samples are U-234, and U-238.

Detailed summaries are provided in the form of tables in the following sections which are organized by contaminant. Section 2 considers metallic contaminants and Section 3 considers radiological contaminants. The quantity referred to as "count" is the number of measured concentrations remaining after excluding U flags and other data deemed to be unusable due to laboratory problems. Blank cells for counts indicate that the laboratory did not analyze for that contaminant. Zero counts indicate that an attempt was made to measure the contaminant, but none of the data were usable. Blank cells for statistics other than counts indicate that none of the data were usable for that contaminant.



*concentrations are measured in mg/kg for sediment and µg/L in water.

Figure D1-6-6. Mean concentration* of metals in waste pond samples.

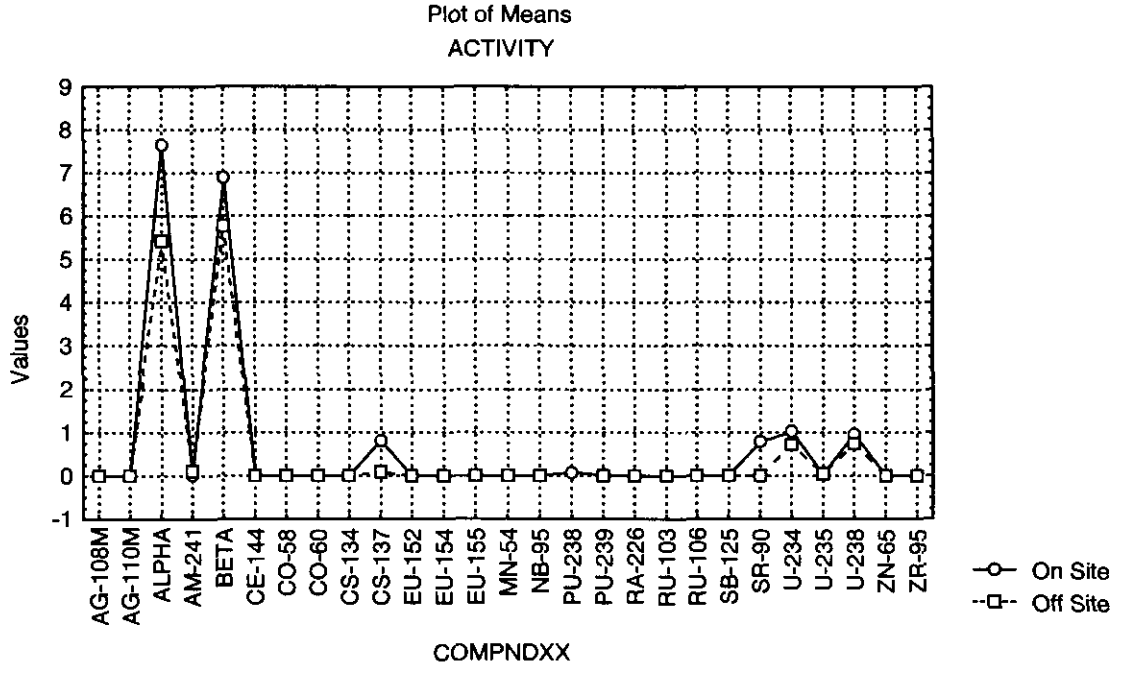
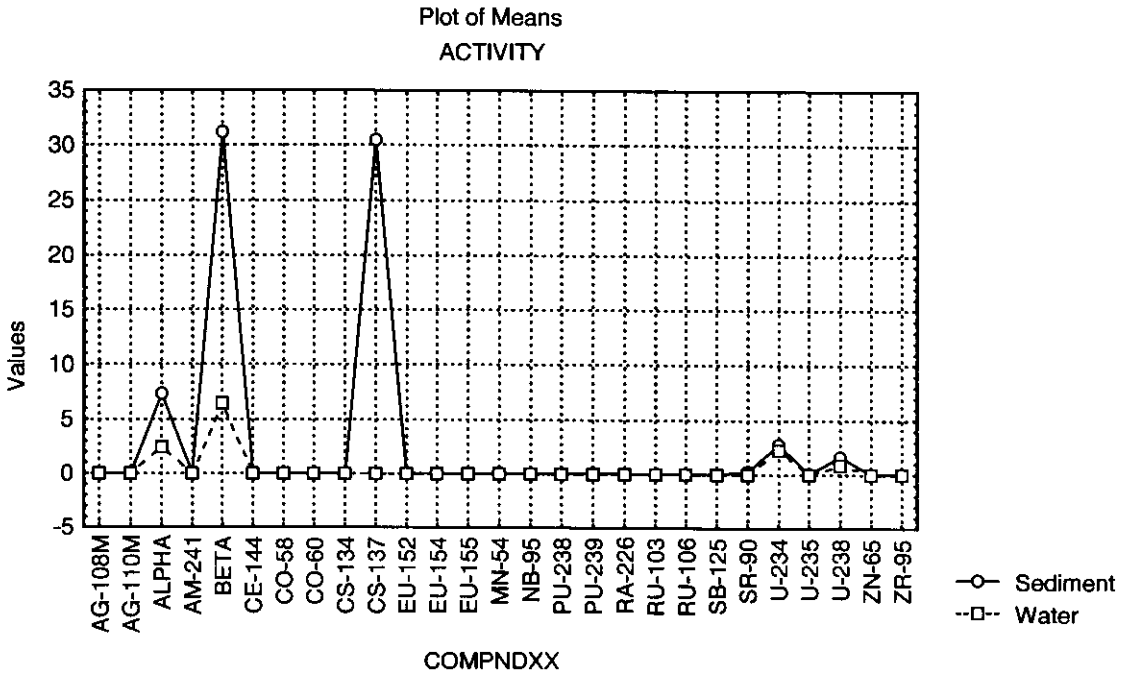


Figure D1-6-7. Mean concentration of radiological activity in surface soil samples (pCi/kg).



*concentrations are measured in pCi/kg for sediment and pCi/L in water.

Figure D1-6-8. Mean concentration* of radiological activity in waste pond samples.

D1-6-2.1 Aluminum

The data for aluminum included several with quality flags; 12 N flags for wheatgrass, 9 J flags for surface soil, and 2 J flags for water. More detailed results are given in Table D1-6-1. The t test indicates a significant difference on-Site versus off-Site for beetles and sagebrush.

D1-6-2.2 Antimony

For the antimony measurements there were 9 U flags for beetles, 10 for grasshoppers, 9 for sagebrush, 12 for wheatgrass, 9 for surface soil, two for sediment, and two for water. There were 12 N flags for wheatgrass. More detailed results are given in Table D1-6-2.

D1-6-2.3 Arsenic

The data for arsenic included one U flag for sagebrush. There was also one B flag for sagebrush, 10 E flags for beetles, 10 N flags for grasshoppers, 12 N flags for wheatgrass, one N*+J flag for sediment, one N*J flag for sediment, 9 NSJ flags for surface soil, and one WUJ flag for water. More detailed results are provided in Table D1-6-3.

Table D1-6-1. Summary of aluminum concentrations.

		Aluminum[a]					
Location	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle	5	212.40	176.00	249.00	73.00	28.66
Off-Site	Beetle	5	454.20	387.00	539.00	152.00	60.98
On-Site	Grasshopper	5	271.00	228.00	319.00	91.00	39.65
Off-Site	Grasshopper	5	349.60	254.00	422.00	168.00	66.85
On-Site	Sagebrush	6	87.20	69.50	135.00	65.50	23.98
Off-Site	Sagebrush	5	59.34	49.10	70.80	21.70	9.81
On-Site	Wheatgrass	6	88.27	49.20	159.00	109.80	51.63
Off-Site	Wheatgrass	6	123.42	94.50	142.00	47.50	15.90
On-Site	Surface Soil	3	9,016.67	6,490.00	10,900.00	4,410.00	2274.30
Off-Site	Surface Soil	6	12,333.33	10,500.00	15,900.00	5,400.00	2,207.86
On-Site	Sediment	2	8,970.00	7,240.00	10,700.00	3,460.00	2,446.59
On-Site	Water	2	405.00	395.00	415.00	20.00	14.14

a. Concentration of water measured in µg/L and all other matrices in mg/kg.

b. Number of useable measured concentrations.

Table D1-6-2. Summary of antimony concentrations.

		Antimony[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle	1	0.04	0.04	0.04		
Off-Site	Beetle	0					
On-Site	Grasshopper	0					
Off-Site	Grasshopper	0					
On-Site	Sagebrush	2	0.02	0.01	0.02	0.01	0.01
Off-Site	Sagebrush	0					
On-Site	Wheatgrass	0					
Off-Site	Wheatgrass	0					
On-Site	Surface Soil	0					
Off-Site	Surface Soil	0					
On-Site	Sediment	0					
On-Site	Water	0					

a. Concentration of water measured in µg/L and all other matrices in mg/kg.

b. Number of useable measured concentrations.

Table D1-6-3. Summary of arsenic concentrations.

		Arsenic[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle	5	0.57	0.48	0.66	0.18	0.07
Off-Site	Beetle	5	0.45	0.38	0.57	0.19	0.09
On-Site	Grasshopper	5	0.25	0.22	0.28	0.06	0.03
Off-Site	Grasshopper	5	0.31	0.24	0.45	0.21	0.08
On-Site	Sagebrush	6	0.18	0.17	0.21	0.04	0.02
Off-Site	Sagebrush	4	0.17	0.15	0.19	0.04	0.02
On-Site	Wheatgrass	6	0.11	0.07	0.16	0.09	0.03
Off-Site	Wheatgrass	6	0.12	0.08	0.15	0.07	0.03
On-Site	Surface Soil	3	4.37	4.30	4.40	0.10	0.06
Off-Site	Surface Soil	6	4.43	3.80	6.30	2.50	0.96
On-Site	Sediment	2	8.20	6.40	10.00	3.60	2.55
On-Site	Water	2	3.60	2.50	4.70	2.20	1.56

a. Concentration of water measured in µg/L and all other matrices in mg/kg.

b. Number of useable measured concentrations.

D1-6-2.4 Barium

The data for barium included 9 U flags for grasshoppers. There were also two B flags for water. More detailed results are provided in Table D1-6-4.

D1-6-2.5 Beryllium

The data for beryllium included 6 U flags for beetles, 9 for sagebrush, 11 for wheatgrass, one for sediment and 2 for water. There was also one B flag for sediment. More detailed results are provided in Table D1-6-5.

D1-6-2.6 Boron

The data for boron included one U flag for water. There were also 12 *J flags for surface soil and 2 J flags for sediment. More detailed results are provided in Table D1-6-6. The t test indicates a significant difference on-Site versus off-Site for sagebrush, wheatgrass, and surface soil.

D1-6-2.7 Cadmium

The data for cadmium included 4 U flags for sagebrush, 12 for wheatgrass, 5 for surface soil, and 2 for water. More detailed results are provided in Table D1-6-7. The t test indicates a significant difference on-Site versus off-Site for beetles and grasshoppers.

Table D1-6-4. Summary of barium concentrations.

		Barium[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle	5	9.38	7.40	11.20	3.80	1.58
Off-Site	Beetle	5	7.44	6.90	8.60	1.70	0.72
On-Site	Grasshopper	1	6.70	6.70	6.70		
Off-Site	Grasshopper	0					
On-Site	Sagebrush	6	5.23	5.00	5.60	0.60	0.23
Off-Site	Sagebrush	5	4.60	4.10	5.50	1.40	0.53
On-Site	Wheatgrass	6	16.75	3.60	44.20	40.60	14.13
Off-Site	Wheatgrass	6	11.45	7.60	12.40	4.80	1.89
On-Site	Surface Soil	3	190.33	139.00	233.00	94.00	47.60
Off-Site	Surface Soil	6	201.50	175.00	238.00	63.00	22.51
On-Site	Sediment	2	184.50	155.00	214.00	59.00	41.72
On-Site	Water	2	50.80	45.90	55.70	9.80	6.93

a. Concentration of water measured in µg/L and all other matrices in mg/kg.
b. Number of useable measured concentrations.

Table D1-6-5. Summary of beryllium concentrations.

		Beryllium[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle	0					
Off-Site	Beetle	4	0.02	0.02	0.02	0.00	0.00
On-Site	Grasshopper	5	0.01	0.01	0.02	0.01	0.00
Off-Site	Grasshopper	5	0.02	0.01	0.02	0.01	0.01
On-Site	Sagebrush	2	0.01	0.01	0.01	0.00	0.00
Off-Site	Sagebrush	0					
On-Site	Wheatgrass	1	0.01	0.01	0.01		
Off-Site	Wheatgrass	0					
On-Site	Surface Soil	3	0.59	0.44	0.76	0.32	0.16
Off-Site	Surface Soil	6	0.68	0.56	0.85	0.29	0.11
On-Site	Sediment	1	0.62	0.62	0.62		
On-Site	Water	0					

a. Concentration of water measured in µg/L and all other matrices in mg/kg.
b. Number of useable measured concentrations.

Table D1-6-6. Summary of boron concentrations.

		Boron[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle	5	4.86	3.70	7.30	3.60	1.46
Off-Site	Beetle	5	3.52	3.10	3.80	0.70	0.30
On-Site	Grasshopper	5	2.02	1.30	4.20	2.90	1.23
Off-Site	Grasshopper	5	2.00	1.40	2.80	1.40	0.55
On-Site	Sagebrush	6	13.35	10.40	16.70	6.30	2.42
Off-Site	Sagebrush	5	22.04	19.20	27.20	8.00	3.11
On-Site	Wheatgrass	6	3.23	2.60	4.30	1.70	0.67
Off-Site	Wheatgrass	6	7.42	5.70	9.60	3.90	1.44
On-Site	Surface Soil	6	6.57	4.80	9.20	4.40	1.62
Off-Site	Surface Soil	6	12.57	9.50	17.30	7.80	2.79
On-Site	Sediment	2	14.45	6.80	22.10	15.30	10.82
On-Site	Water	1	68.70	68.70	68.70		

a. Concentration of water measured in µg/L and all other matrices in mg/kg.

b. Number of useable measured concentrations.

Table D1-6-7. Summary of cadmium concentrations.

		Cadmium[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle	5	0.17	0.14	0.21	0.07	0.03
Off-Site	Beetle	5	0.08	0.01	0.11	0.10	0.04
On-Site	Grasshopper	5	0.11	0.08	0.13	0.05	0.02
Off-Site	Grasshopper	5	0.06	0.05	0.10	0.05	0.02
On-Site	Sagebrush	6	0.14	0.10	0.25	0.15	0.06
Off-Site	Sagebrush	1	0.10	0.10	0.10		
On-Site	Wheatgrass	0					
Off-Site	Wheatgrass	0					
On-Site	Surface Soil	2	0.64	0.61	0.67	0.06	0.06
Off-Site	Surface Soil	2	0.47	0.41	0.53	0.12	0.12
On-Site	Sediment	2	2.70	0.79	4.60	3.81	2.69
On-Site	Water	0					

a. Concentration of water measured in µg/L and all other matrices in mg/kg.

b. Number of useable measured concentrations.

D1-6-2.8 Calcium

No measurements of calcium were made for the biotic samples. There were no U flags or quality flags for the matrices which were analyzed. More detailed results are provided in Table D1-6-8. The t test indicates a significant difference on-Site versus off-Site for surface soil.

D1-6-2.9 Chromium

The data for chromium included two * flags for sediment and 10 NJ flags for surface soil. More detailed results are given in Table D1-6-9. The t test indicates a significant difference on-Site versus off-Site for sagebrush and surface soil.

D1-6-2.10 Cobalt

The data for cobalt included 4 U flags for grasshoppers, 11 for sagebrush, and 12 for wheatgrass. There was one B flag for sediment. More detailed results are given in Table D1-6-10. The t test indicates a significant difference on-Site versus off-Site for beetles.

D1-6-2.11 Copper

The data for copper included 2 U flags for water. More detailed results are given in Table D1-6-11.

D1-6-2.12 Cyanide

No measurements of cyanide were made for the biotic samples or soil samples. The data for cyanide included two U flags for water. Detailed results are given in Table D1-6-12.

D1-6-2.13 Iron

No measurements of iron were made for the biotic samples. There were no U flags or quality flags for the matrices which were analyzed. More detailed results are provided in Table D1-6-13.

D1-6-2.14 Lead

There was one U flag for water. More detailed results are provided in Table D1-6-14.

D1-6-2.15 Magnesium

No measurements of magnesium were made for the biotic samples. There were no U flags or quality flags for the matrices which were analyzed. More detailed results are provided in Table D1-6-15.

Table D1-6-8. Summary of calcium concentrations.

		Calcium[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle						
Off-Site	Beetle						
On-Site	Grasshopper						
Off-Site	Grasshopper						
On-Site	Sagebrush						
Off-Site	Sagebrush						
On-Site	Wheatgrass						
Off-Site	Wheatgrass						
On-Site	Surface Soil	3	15900.00	10500.00	19900.00	9400.00	4853.86
Off-Site	Surface Soil	6	39783.33	22600.00	65900.00	43300.00	17400.85
On-Site	Sediment	2	37250.00	34600.00	39900.00	5300.00	3747.67
On-Site	Water	2	44450.00	37700.00	51200.00	13500.00	9545.94

a. Concentration of water measured in µg/L and all other matrices in mg/kg.

b. Number of useable measured concentrations.

Table D1-6-9. Summary of chromium concentrations.

		Chromium[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle	5	1.92	1.30	3.00	1.70	0.67
Off-Site	Beetle	5	2.00	1.70	2.20	0.50	0.21
On-Site	Grasshopper	5	1.03	0.86	1.20	0.34	0.16
Off-Site	Grasshopper	5	1.44	0.81	2.00	1.19	0.50
On-Site	Sagebrush	6	0.41	0.30	0.61	0.31	0.11
Off-Site	Sagebrush	5	0.21	0.17	0.22	0.05	0.02
On-Site	Wheatgrass	6	2.63	1.70	4.00	2.30	1.09
Off-Site	Wheatgrass	6	2.48	2.20	2.90	0.70	0.27
On-Site	Surface Soil	4	21.60	17.30	25.80	8.50	3.67
Off-Site	Surface Soil	6	14.88	13.10	17.50	4.40	1.81
On-Site	Sediment	2	2283.50	277.00	4290.00	4013.00	2837.62
On-Site	Water	2	17.70	16.40	19.00	2.60	1.84

a. Concentration of water measured in µg/L and all other matrices in mg/kg.

b. Number of useable measured concentrations.

Table D1-6-10. Summary of cobalt concentrations.

		Cobalt[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle	5	0.20	0.16	0.22	0.06	0.03
Off-Site	Beetle	5	0.28	0.19	0.34	0.15	0.06
On-Site	Grasshopper	1	0.40	0.40	0.40		
Off-Site	Grasshopper	5	0.27	0.20	0.32	0.12	0.05
On-Site	Sagebrush	0					
Off-Site	Sagebrush	0					
On-Site	Wheatgrass	0					
Off-Site	Wheatgrass	0					
On-Site	Surface Soil	4	6.63	5.20	8.20	3.00	1.28
Off-Site	Surface Soil	6	7.17	6.50	7.90	1.40	0.58
On-Site	Sediment	2	6.35	6.10	6.60	0.50	0.35
On-Site	Water	0					

a. Concentration of water measured in µg/L and all other matrices in mg/kg.

b. Number of useable measured concentrations.

Table D1-6-11. Summary of copper concentrations.

		Copper[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle	5	7.56	6.40	8.50	2.10	0.81
Off-Site	Beetle	5	8.20	7.80	8.90	1.10	0.48
On-Site	Grasshopper	5	22.38	19.40	24.90	5.50	1.99
Off-Site	Grasshopper	5	18.36	13.20	21.80	8.60	3.14
On-Site	Sagebrush	6	6.82	4.90	8.00	3.10	1.21
Off-Site	Sagebrush	5	5.40	4.00	6.20	2.20	0.86
On-Site	Wheatgrass	6	2.03	1.50	2.60	1.10	0.43
Off-Site	Wheatgrass	6	1.58	1.40	1.70	0.30	0.12
On-Site	Surface Soil	4	15.98	11.90	20.70	8.80	4.02
Off-Site	Surface Soil	6	14.80	13.20	18.40	5.20	1.98
On-Site	Sediment	2	53.85	21.60	86.10	64.50	45.61
On-Site	Water	0					

a. Concentration of water measured in µg/L and all other matrices in mg/kg.

b. Number of useable measured concentrations.

Table D1-6-12. Summary of cyanide concentrations.

		Cyanide[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle						
On-Site	Grasshopper						
On-Site	Sagebrush						
On-Site	Wheatgrass						
On-Site	Surface Soil						
On-Site	Sediment						
On-Site	Water	0					

a. Concentration of water measured in µg/L and all other matrices in mg/kg.

b. Number of useable measured concentrations.

Table D1-6-13. Summary of iron concentrations.

		Iron[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle						
Off-Site	Beetle						
On-Site	Grasshopper						
Off-Site	Grasshopper						
On-Site	Sagebrush						
Off-Site	Sagebrush						
On-Site	Wheatgrass						
Off-Site	Wheatgrass						
On-Site	Surface Soil	4	13925.00	11600.00	16300.00	4700.00	2054.87
Off-Site	Surface Soil	6	13650.00	11700.00	16700.00	5000.00	2085.91
On-Site	Sediment	2	13500.00	12200.00	14800.00	2600.00	1838.48
On-Site	Water	2	484.00	373.00	595.00	222.00	156.98

a. Concentration of water measured in µg/L and all other matrices in mg/kg.

b. Number of useable measured concentrations.

Table D1-6-14. Summary of lead concentrations.

		Lead[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle	5	0.53	0.31	0.95	0.64	0.28
Off-Site	Beetle	5	0.45	0.38	0.53	0.15	0.06
On-Site	Grasshopper	5	0.29	0.22	0.35	0.13	0.05
Off-Site	Grasshopper	5	0.34	0.24	0.46	0.22	0.08
On-Site	Sagebrush	6	0.15	0.11	0.20	0.09	0.03
Off-Site	Sagebrush	5	0.16	0.11	0.23	0.12	0.05
On-Site	Wheatgrass	6	0.17	0.08	0.22	0.14	0.06
Off-Site	Wheatgrass	6	0.19	0.13	0.33	0.20	0.07
On-Site	Surface Soil	4	13.40	11.60	15.20	3.60	1.91
Off-Site	Surface Soil	6	13.35	11.30	14.70	3.40	1.34
On-Site	Sediment	2	20.65	12.20	29.10	16.90	11.95
On-Site	Water	1	6.30	6.30	6.30		

a. Concentration of water measured in µg/L and all other matrices in mg/kg.
b. Number of useable measured concentrations.

Table D1-6-15. Summary of magnesium concentrations.

		Magnesium[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle						
Off-Site	Beetle						
On-Site	Grasshopper						
Off-Site	Grasshopper						
On-Site	Sagebrush						
Off-Site	Sagebrush						
On-Site	Wheatgrass						
Off-Site	Wheatgrass						
On-Site	Surface Soil	4	8350.00	5580.00	9750.00	4170.00	1931.10
Off-Site	Surface Soil	6	9258.33	7480.00	11000.00	3520.00	1394.19
On-Site	Sediment	2	15500.00	10600.00	20400.00	9800.00	6929.65
On-Site	Water	2	12900.00	11600.00	14200.00	2600.00	1838.48

a. Concentration of water measured in µg/L and all other matrices in mg/kg.
b. Number of useable measured concentrations.

D1-6-2.16 Manganese

For the manganese data there were two U flags. More detailed results are provided in Table D1-6-16. The t test indicates a significant difference on-Site versus off-Site for beetles, grasshoppers, sagebrush, wheatgrass, and surface soil.

D1-6-2.17 Mercury

For the mercury data, there were 6 U flags for grasshoppers, 5 for sagebrush, 11 for wheatgrass, one for surface soil, and two for water. There were 6 B flags for surface soil, 6 J flags for surface soil and 11 N flags for sagebrush. More details are provided by Table D1-6-17.

D1-6-2.18 Molybdenum

For the molybdenum data, there were 12 U flags for surface soil and two for water. There were two J flags for sediment. More details are provided by Table D1-6-18.

D1-6-2.19 Nickel

For the nickel data, there were 4 U flags for sagebrush and two for water. More details are provided in Table D1-6-19.

D1-6-2.20 Potassium

No measurements of potassium were made for the biotic samples. For the potassium data, there was one B flag for water and 10 *J flags for surface soil. More details are provided by Table D1-6-20.

D1-6-2.21 Selenium

For the selenium data, there were 11 NE flags for sagebrush. More details are provided by Table D1-6-21.

D1-6-2.22 Silver

For the silver data, there were 3 U flags for beetles, 11 for sagebrush, 5 for wheatgrass, 4 for surface soil, and two for water. There was one B flag for sediment and two NJ flags for sediment. More details are provided by Table D1-6-22.

D1-6-2.23 Sodium

No measurements of sodium were made for the biotic samples. There were 4 B flags for surface soil and 2 for sediment. More detailed results are provided in Table D1-6-23.

Table D1-6-16. Summary of manganese concentrations.

		Manganese[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle	5	13.82	12.20	15.40	3.20	1.17
Off-Site	Beetle	5	19.90	17.90	23.00	5.10	1.91
On-Site	Grasshopper	5	8.88	7.80	9.60	1.80	0.67
Off-Site	Grasshopper	5	11.82	9.40	13.60	4.20	1.66
On-Site	Sagebrush	6	15.85	12.60	19.70	7.10	2.47
Off-Site	Sagebrush	5	19.80	17.00	22.80	5.80	2.35
On-Site	Wheatgrass	6	19.25	11.80	23.70	11.90	4.46
Off-Site	Wheatgrass	6	26.13	23.80	28.40	4.60	1.85
On-Site	Surface Soil	4	240.75	179.00	322.00	143.00	62.11
Off-Site	Surface Soil	6	450.50	377.00	506.00	129.00	54.66
On-Site	Sediment	2	261.50	156.00	367.00	211.00	149.20
On-Site	Water	2	11.80	11.10	12.50	1.40	0.99

a. Concentration of water measured in µg/L and all other matrices in mg/kg.
b. Number of useable measured concentrations.

Table D1-6-17. Summary of mercury concentrations.

		Mercury[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle	5	0.02	0.02	0.03	0.01	0.01
Off-Site	Beetle	5	0.03	0.02	0.04	0.02	0.01
On-Site	Grasshopper	4	0.01	0.01	0.02	0.01	0.01
Off-Site	Grasshopper	0					
On-Site	Sagebrush	6	0.02	0.01	0.04	0.03	0.01
Off-Site	Sagebrush	0					
On-Site	Wheatgrass	1	0.03	0.03	0.03		
Off-Site	Wheatgrass	0					
On-Site	Surface Soil	4	0.04	0.03	0.05	0.02	0.01
Off-Site	Surface Soil	5	0.04	0.03	0.08	0.05	0.02
On-Site	Sediment	2	0.97	0.14	1.80	1.66	1.17
On-Site	Water	0					

a. Concentration of water measured in µg/L and all other matrices in mg/kg.
b. Number of useable measured concentrations.

Table D1-6-18. Summary of molybdenum concentrations.

		Molybdenum[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle	5	0.56	0.38	0.65	0.27	0.10
Off-Site	Beetle	5	0.50	0.41	0.58	0.17	0.06
On-Site	Grasshopper	5	0.60	0.54	0.64	0.10	0.04
Off-Site	Grasshopper	5	0.57	0.49	0.61	0.12	0.05
On-Site	Sagebrush	6	0.26	0.22	0.33	0.11	0.05
Off-Site	Sagebrush	5	0.44	0.29	0.70	0.41	0.18
On-Site	Wheatgrass	6	0.69	0.53	0.78	0.25	0.09
Off-Site	Wheatgrass	6	0.93	0.66	1.20	0.54	0.19
On-Site	Surface Soil	0					
Off-Site	Surface Soil	0					
On-Site	Sediment	2	2.35	2.20	2.50	0.30	0.21
On-Site	Water	0					

a. Concentration of water measured in µg/L and all other matrices in mg/kg.

b. Number of useable measured concentrations.

Table D1-6-19. Summary of nickel concentrations.

		Nickel[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle	5	1.05	0.72	1.70	0.98	0.38
Off-Site	Beetle	5	0.88	0.75	0.94	0.19	0.07
On-Site	Grasshopper	5	0.73	0.60	0.87	0.27	0.13
Off-Site	Grasshopper	5	0.61	0.39	0.79	0.40	0.17
On-Site	Sagebrush	6	0.63	0.47	0.75	0.28	0.11
Off-Site	Sagebrush	1	0.45	0.45	0.45		
On-Site	Wheatgrass	6	1.23	0.75	1.90	1.15	0.48
Off-Site	Wheatgrass	6	1.16	0.95	1.40	0.45	0.17
On-Site	Surface Soil	4	26.78	21.00	33.00	12.00	5.27
Off-Site	Surface Soil	6	17.68	15.60	20.30	4.70	1.70
On-Site	Sediment	2	24.15	20.90	27.40	6.50	4.60
On-Site	Water	0					

a. Concentration of water measured in µg/L and all other matrices in mg/kg.

b. Number of useable measured concentrations.

Table D1-6-20. Summary of potassium concentrations.

		Potassium[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle						
Off-Site	Beetle						
On-Site	Grasshopper						
Off-Site	Grasshopper						
On-Site	Sagebrush						
Off-Site	Sagebrush						
On-Site	Wheatgrass						
Off-Site	Wheatgrass						
On-Site	Surface Soil	4	1417.50	1030.00	1800.00	770.00	337.38
Off-Site	Surface Soil	6	2435.00	1790.00	3310.00	1520.00	533.69
On-Site	Sediment	2	2490.00	1850.00	3130.00	1280.00	905.10
On-Site	Water	2	4990.00	3520.00	6460.00	2940.00	2078.89

a. Concentration of water measured in µg/L and all other matrices in mg/kg.

b. Number of useable measured concentrations.

Table D1-6-21. Summary of selenium concentrations.

		Selenium[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle	5	0.13	0.04	0.22	0.18	0.08
Off-Site	Beetle	5	0.04	0.04	0.04	0.00	0.00
On-Site	Grasshopper	5	0.45	0.21	0.68	0.47	0.21
Off-Site	Grasshopper	5	0.11	0.10	0.13	0.03	0.01
On-Site	Sagebrush	6	0.27	0.07	0.53	0.46	0.17
Off-Site	Sagebrush	5	0.03	0.01	0.05	0.04	0.02
On-Site	Wheatgrass	6	0.19	0.03	0.48	0.45	0.17
Off-Site	Wheatgrass	6	0.04	0.01	0.09	0.08	0.03
On-Site	Surface Soil	4	0.24	0.20	0.26	0.06	0.03
Off-Site	Surface Soil	6	0.25	0.22	0.27	0.05	0.02
On-Site	Sediment	2	0.74	0.28	1.20	0.92	0.65
On-Site	Water	2	2.50	2.50	2.50	0.00	0.00

a. Concentration of water measured in µg/L and all other matrices in mg/kg.

b. Number of useable measured concentrations.

Table D1-6-22. Summary of silver concentrations.

		Silver[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle	2	0.02	0.01	0.02	0.01	0.01
Off-Site	Beetle	5	0.03	0.03	0.03	0.00	0.00
On-Site	Grasshopper	5	0.03	0.02	0.03	0.01	0.01
Off-Site	Grasshopper	5	0.02	0.02	0.02	0.00	0.00
On-Site	Sagebrush	0					
Off-Site	Sagebrush	0					
On-Site	Wheatgrass	1	0.01	0.01	0.01		
Off-Site	Wheatgrass	6	0.01	0.01	0.01	0.00	0.00
On-Site	Surface Soil	0					
Off-Site	Surface Soil	0					
On-Site	Sediment	2	18.60	1.10	36.10	35.00	24.75
On-Site	Water	0					

a. Concentration of water measured in µg/L and all other matrices in mg/kg.

b. Number of useable measured concentrations

Table D1-6-23. Summary of sodium concentrations.

		Sodium[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle						
Off-Site	Beetle						
On-Site	Grasshopper						
Off-Site	Grasshopper						
On-Site	Sagebrush						
Off-Site	Sagebrush						
On-Site	Wheatgrass						
Off-Site	Wheatgrass						
On-Site	Surface Soil	4	405.25	337.00	472.00	135.00	60.32
Off-Site	Surface Soil	6	1117.17	700.00	1920.00	1220.00	442.48
On-Site	Sediment	2	543.00	416.00	670.00	254.00	179.61
On-Site	Water	2	20350.00	17800.00	22900.00	5100.00	3606.24

a. Concentration of water measured in µg/L and all other matrices in mg/kg.

b. Number of useable measured concentrations

D1-6-2.24 Strontium

For the strontium data, there were two J flags for sediment. More details are provided by Table D1-6-24.

D1-6-2.25 Thallium

For the thallium data, there were 5 U flags for beetles, 8 for sagebrush, 12 for wheatgrass, 7 for surface soil, and one for sediment. There were 3 B flags for surface soil, one WUJ flag for sediment, and two WUJ flags for water. More details are provided by Table D1-6-25.

D1-6-2.26 Vanadium

For the vanadium data, there was 1 U flag for sagebrush, 5 for wheatgrass, and two for water. More details are provided by Table D1-6-26.

D1-6-2.27 Zinc

For the zinc data, there were 11 N flags for sagebrush and 10 N*J flags for surface soil. More details are provided by Table D1-6-27.

D1-6-2.28 Radiological Contaminants

The preliminary evaluation does not include non-detects in the calculations for radiological contaminants. This will be corrected when this evaluation is finalized for the OU 10-04 ERA.

D1-6-2.29 Ag-108M

For the Ag-108M measurements, there was one UJ flag for a sediment sample and all other data were U flags.

D1-6-2.30 Ag-110M

For the Ag-110M measurements, all data were U flags.

D1-6-2.31 Am-241

For the Am-241 measurements, there were 16 U flags for surface soil, 3 for sediment and 4 for water. There were 3 UJ flags for surface soil. Table D1-6-28 details the results.

D1-6-2.32 Ce-144

For the Ce-144 measurements, all data had U flags.

Table D1-6-24. Summary of strontium concentrations.

		Strontium[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle	5	6.02	4.70	8.00	3.30	1.34
Off-Site	Beetle	5	6.12	5.40	6.80	1.40	0.55
On-Site	Grasshopper	5	3.84	3.10	5.40	2.30	0.90
Off-Site	Grasshopper	5	3.08	2.10	4.50	2.40	0.92
On-Site	Sagebrush	6	11.80	10.40	13.70	3.30	1.20
Off-Site	Sagebrush	5	13.28	9.30	15.50	6.20	2.52
On-Site	Wheatgrass	6	9.48	6.70	11.30	4.60	1.80
Off-Site	Wheatgrass	6	10.63	9.20	13.70	4.50	1.78
On-Site	Surface Soil	6	58.17	35.30	72.30	37.00	12.59
Off-Site	Surface Soil	6	82.70	66.50	126.00	59.50	23.39
On-Site	Sediment	2	62.40	57.40	67.40	10.00	7.07
On-Site	Water	2	153.00	134.00	172.00	38.00	26.87

a. Concentration of water measured in µg/L and all other matrices in mg/kg.

b. Number of useable measured concentrations

Table D1-6-25. Summary of thallium concentrations.

		Thallium[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle	0					
Off-Site	Beetle	5	0.01	0.01	0.01	0.00	0.00
On-Site	Grasshopper	5	0.01	0.01	0.01	0.00	0.00
Off-Site	Grasshopper	5	0.01	0.01	0.01	0.00	0.00
On-Site	Sagebrush	3	0.01	0.01	0.01	0.00	0.00
Off-Site	Sagebrush	0					
On-Site	Wheatgrass	0					
Off-Site	Wheatgrass	0					
On-Site	Surface Soil	0					
Off-Site	Surface Soil	3	0.23	0.23	0.24	0.01	0.01
On-Site	Sediment	0					
On-Site	Water	0					

a. Concentration of water measured in µg/L and all other matrices in mg/kg.

b. Number of useable measured concentrations

Table D1-6-26. Summary of vanadium concentrations.

		Vanadium[a]				
	Matrix	Count[a]	Mean	Min	Max	Range	St Dev
On-Site	Beetle	5	0.60	0.41	0.75	0.34	0.13
Off-Site	Beetle	5	0.97	0.78	1.20	0.42	0.15
On-Site	Grasshopper	5	0.81	0.66	0.93	0.27	0.12
Off-Site	Grasshopper	5	0.85	0.61	1.10	0.49	0.19
On-Site	Sagebrush	6	0.21	0.11	0.35	0.24	0.08
Off-Site	Sagebrush	4	0.14	0.12	0.17	0.05	0.02
On-Site	Wheatgrass	2	0.38	0.38	0.38	0.00	0.00
Off-Site	Wheatgrass	5	0.27	0.25	0.30	0.05	0.02
On-Site	Surface Soil	4	21.93	19.60	25.00	5.40	2.33
Off-Site	Surface Soil	6	20.50	17.30	22.60	5.30	2.17
On-Site	Sediment	2	37.60	25.60	49.60	24.00	16.97
On-Site	Water	0					

a. Concentration of water measured in µg/L and all other matrices in mg/kg.

b. Number of useable measured concentrations

Table D1-6-27. Summary of zinc concentrations.

		Zinc[a]				
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Beetle	5	37.12	31.90	49.30	17.40	6.99
Off-Site	Beetle	5	25.32	23.40	26.70	3.30	1.44
On-Site	Grasshopper	5	58.42	53.10	65.60	12.50	5.95
Off-Site	Grasshopper	5	43.00	38.60	50.30	11.70	4.69
On-Site	Sagebrush	6	17.85	12.90	22.40	9.50	3.41
Off-Site	Sagebrush	5	11.40	9.90	13.60	3.70	1.52
On-Site	Wheatgrass	6	15.85	11.40	24.70	13.30	5.07
Off-Site	Wheatgrass	6	8.03	6.70	9.70	3.00	1.25
On-Site	Surface Soil	4	106.58	77.80	136.00	58.20	25.06
Off-Site	Surface Soil	6	53.43	43.90	68.80	24.90	9.28
On-Site	Sediment	2	1133.50	207.00	2060.00	1853.00	1310.27
On-Site	Water	2	25.85	22.40	29.30	6.90	4.88

a. Concentration of water measured in µg/L and all other matrices in mg/kg.

b. Number of useable measured concentrations

Table D1-6-28. Summary of Am-241 concentrations.

		Am-241[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Surface Soil	2	0.06	0.04	0.07	0.03	0.02
Off-Site	Surface Soil	3	0.11	0.02	0.26	0.25	0.13
On-Site	Sediment	1	0.07	0.07	0.07		
On-Site	Water	0					

a. Concentration of water measured in pCi/L and all other matrices in pCi/kg.

b. Number of useable measured concentrations.

D1-6-2.33 Co-58

For the Co-58 measurements, all data had U flags.

D1-6-2.34 Co-60

For the Co-60 measurements, there were 11 U flags for surface soil, 1 for sediment, and 2 for water. There was one UJ flag for surface soil and one for sediment.

D1-6-2.35 Cs-134

For the Cs-134 measurements, there was one UJ flag for surface soil and all others had U flags.

D1-6-2.36 Cs-137

For the Cs-137 measurements, there were 4 U flags for surface soil and 2 for water. There were two UJ flags for surface soil and two J flags for surface soil. Table D1-6-29 details the results.

D1-6-2.37 Eu-152

For the Eu-152 measurements, all data had U flags.

D1-6-2.38 Eu-154

For the Eu-154 measurements, there were 9 U flags for surface soil, two for sediment, and two for water. There were 3 UJ flags for surface soil.

D1-6-2.39 Eu-155

For the Eu-155 measurements, there was one UJ flag for sediment and all other data had U flags.

Table D1-6-29. Summary of Cs-137 concentrations.

		Cs-137[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Surface Soil	5	0.82	0.12	2.88	2.76	1.18
Off-Site	Surface Soil	1	0.10	0.10	0.10		
On-Site	Sediment	2	30.50	15.10	45.90	30.80	21.78
On-Site	Water	0					

a. Concentration of water measured in pCi/L and all other matrices in pCi/kg.

b. Number of useable measured concentrations

D1-6-2.40 Mn-54

For the Mn-54 measurements, there was one UJ flag for surface soil and all other data had U flags.

D1-6-2.41 Nb-95

For the Nb-95 measurements, there was one UJ flag for surface soil and all other data had U flags.

D1-6-2.42 Pu-238

For the Pu-238 measurements, there were 8 U flags for surface soil, two for sediment, and two for water. There were 3 UJ flags for surface soil and one J flag for surface soil. Table D1-6-30 details the results.

D1-6-2.43 Pu-239

For the Pu-239 measurements, there were 8 U flags for surface soil and one for water. There were two UJ flags for surface soil and one for water. There were two J flags for surface soil and one for sediment. Table D1-6-31 details the results.

D1-6-2.44 Ra-226

For the Ra-226 measurements, there were two U flags for water and all other data had UJ flags.

D1-6-2.45 Ru-103

For the Ru-103 measurements, all data had U flags.

D1-6-2.46 Ru-106

For the Ru-106 measurements, all data had U flags.

Table D1-6-30. Summary of Pu-238 concentrations.

		Pu-238[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Surface Soil	1	0.08	0.08	0.08		
Off-Site	Surface Soil	0					
On-Site	Sediment	0					
On-Site	Water	0					

a. Concentration of water measured in pCi/L and all other matrices in pCi/kg.

b. Number of useable measured concentrations

Table D1-6-31. Summary of Pu-239 concentrations.

		Pu-239[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Surface Soil	2	0.02	0.02	0.02	0.00	0.00
Off-Site	Surface Soil	0					
On-Site	Sediment	2	0.04	0.02	0.06	0.04	0.03
On-Site	Water	0					

a. Concentration of water measured in pCi/L and all other matrices in pCi/kg.

b. Number of useable measured concentrations

D1-6-2.47 Sb-125

For the Sb-125 measurements, there were two UJ flags for surface soil and all other data had U flags.

D1-6-2.48 Sr-90

For the Sr-90 measurements, there were 8 U flags for surface soil, one for sediment and two for water. There were two UJ flags for surface soil. Table D1-6-32 summarizes the results.

D1-6-2.49 U-234

For the U-234 measurements, there were no flags. Table D1-6-33 summarizes the results.

Table D1-6-32. Summary of Sr-90 concentrations.

		Sr-90[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Surface Soil	2	0.78	0.52	1.05	0.53	0.38
Off-Site	Surface Soil	0					
On-Site	Sediment	1	0.25	0.25	0.25		
On-Site	Water	0					

a. Concentration of water measured in pCi/L and all other matrices in pCi/kg.

b. Number of useable measured concentrations

Table D1-6-33. Summary of U-234 concentrations.

		U-234[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Surface Soil	6	1.023	0.922	1.140	0.218	0.079
Off-Site	Surface Soil	6	0.734	0.686	0.823	0.137	0.054
On-Site	Sediment	2	2.775	1.260	4.290	3.030	2.143
On-Site	Water	2	2.210	1.390	3.030	1.640	1.160

a. Concentration of water measured in pCi/L and all other matrices in pCi/kg.

b. Number of useable measured concentrations

D1-6-2.50 U-235

For the U-235 measurements, there were 12 U flags for surface soil, two for sediment, and two for water. There were two UJ flags for water. Table D1-6-34 details the results.

D1-6-2.51 U-238

For the U-238 measurements, there were no flags. Table D1-6-35 details the results.

D1-6-2.52 Zn-65

For the Zn-65 measurements, all data had U flags.

D1-6-2.53 Zr-95

For the Zr-95 measurements, there were two UJ flags and all other data had U flags.

Table D1-6-34. Summary of U-235 concentrations.

		U-235[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Surface Soil	6	0.04	0.03	0.05	0.02	0.01
Off-Site	Surface Soil	6	0.04	0.03	0.07	0.04	0.01
On-Site	Sediment	2	0.13	0.07	0.20	0.13	0.09
On-Site	Water	0					

a. Concentration of water measured in pCi/L and all other matrices in pCi/kg.

b. Number of useable measured concentrations

Table D1-6-35. Summary of U-238 concentrations.

		U-238[a]					
	Matrix	Count[b]	Mean	Min	Max	Range	St Dev
On-Site	Surface Soil	6	0.97	0.87	1.08	0.21	0.09
Off-Site	Surface Soil	6	0.76	0.69	0.88	0.19	0.07
On-Site	Sediment	2	1.64	0.99	2.30	1.31	0.93
On-Site	Water	2	0.82	0.52	1.11	0.59	0.42

a. Concentration of water measured in pCi/L and all other matrices in pCi/kg.

b. Number of useable measured concentrations

Appendix D1
Attachment 7

Example of Dose Reconstruction and Data Analysis

CONTENTS

TABLES

Attachment 7

Example of Dose Reconstruction and Data Analysis

D1-7-1. INTRODUCTION

Numerous radioecological and descriptive ecological studies have been conducted on the INEEL since 1948. Table D1-7-1 presents the summary of the INEEL publications compiled in 1993 and their applicability to the ERA process as documented in VanHorn et al. (1995).

These studies support the evaluation of historic doses to ecological receptors at the INEEL and the refinement of food web modeling. This attachment presents a preliminary example of dose reconstruction for selected species at WAGs 2 and 3. It is intended to demonstrate the methods to be used to fill the data gap identified in Appendix C2 and is severely limited in that it only includes data from before 1993. The dose reconstruction and data analysis performed for the OU 10-04 ERA should compare past exposures to newer post remediation exposure providing an evaluation of the effectiveness of remediation.

As part of the tasks performed during the development of the screening level guidance (VanHorn et al. 1995) this information was compiled, reviewed, and organized in a manner useful to risk assessors. The first step in this example is to review and discuss the data summarized in VanHorn et al. (1995) for those areas surrounding the WAG 2 (TRA) and WAG 3 (INTEC, formerly ICPP).

D1-7-1.1 Idaho Nuclear Technology and Engineering Center

This summary is taken almost verbatim from Attachment 1 of Appendix C of VanHorn et al. (1995), with some minor corrections and additional discussion. The environment surrounding the INTEC has been contaminated with a variety of fission products and transuranics. Studies of radioactive contamination from INTEC have been conducted in soil, vegetation, rabbits, pronghorn, mourning doves, sage grouse, waterfowl, and fish from the Big Lost River near INTEC. The contaminant concentrations found in these media are discussed in Table D1-7-2.

In at least one case, the sage grouse study (Connelly and Markham 1983), samples were collected from the INTEC/TRA area and no attempt was made to discriminate between the two facilities. Although not generally made explicit, this confounding of data from the two areas may be common for animal studies with some mobile species (e.g., birds or large mammals).

The maximum Cs-137 concentration in soil near INTEC was reported as 54 pCi/g. This is approximately 7% of the Cs-137 concentration (700 pCi/g) in SL-1 soils, the most contaminated soil after TRA Warm Waste Pond sediments. The maximum concentration of ^{137}Cs in INTEC soils was 18 times maximum background concentrations (3.0 pCi/g) reported in Table C-1.1 of VanHorn et al. (1995). This maximum soil concentration is 33.5 times the maximum background presented in Rood et al. (1995) of 1.61 pCi/g (for grab samples 95%/99% UTL).

The maximum soil concentration of Pu-239, 240 in soil near INTEC was 0.073 pCi/g, which is less than 0.002% of that found in Subsurface Disposal Area (SDA) surface soils ([54 pCi/g] the highest concentration reported other than TRA Warm Waste Pond sediments) and 82% of the maximum background (0.089 pCi/g^{-1}) reported in Table C-1.1 of VanHorn et al. (1995). The maximum soil

Table D1-7-1. INEEL publications and their applicability to ecological risk assessment.

Facility or Waste Management Area	Publication	Problem Formulation	Analysis	Risk Characterization
INEEL	Abbott et al. (1991)	X	X	
INEEL	Anderson (1986)	X		X
INEEL	Anderson and Holte (1981)	X		X
INEEL, PBF	Anderson and Marlette (1986)	X		X
RWMC/SDA	Arthur (1982)	X	X	X
INEEL	Arthur and Gates (1988)		X	
RWMC/TSA, RWMC/SDA	Arthur and Janke (1986)	X	X	X
RWMC/SDA, TRA	Arthur and Markham (1982)	X	X	X
RWMC/SDA	Arthur and Markham (1983)	X	X	
RWMC/SDA	Arthur and Markham (1984)	X	X	
INEEL	Arthur et al. (1984)	X		
RWMC/TSA, RWMC/SDA	Arthur et al. (1986)	X	X	
RWMC/SDA	Arthur et al. (1987)	X	X	
INEEL	Blom et al. (1991a)	X	X	
TRA	Blom et al. (1991b)	X	X	
INEEL	Cholewa and Henderson (1984)	X		
INEEL	Clark and Blom (1992)		X	
CFA, TRA, INTEC, RWMC	Connelly and Markham (1983)	X	X	X
INEEL	Connelly et al. (1981)	X		X
INEEL	Connelly et al. (1988)	X	X	
INEEL	Corn (1993)	X		
INEEL	Craig (1978)	X		
INEEL	Craig (1979)	X		
INEEL	Craig and Craig (1984)	X		
INEEL	Craig and Renn (1977)	X	X	
INEEL	Craig and Trost (1979)	X	X	X
INTEC, TRA	Craig et al. (1979)	X	X	X
INEEL	Craig et al. (1984)	X		X
INEEL	Craig et al. (1985)		X	
INEEL	Craig et al. (1986)	X		

Table D1-7-1. (continued).

Facility or Waste Management Area	Publication	Problem Formulation	Analysis	Risk Characterization
INTEC	Fraley et al. (1982)	X	X	X
INEEL	French and Mitchell (1983)	X		X
INEEL	Gates et al. (1985)			X
INEEL	Genter (1986)	X		
INEEL	Gleason and Johnson (1985)	X	X	
RWMC/SDA	Groves and Keller (1983)	X		X
RWMC/SDA	Groves and Keller (1986)	X	X	
INEEL	Guyer and Linder (1985a)	X		
INEEL	Guyer and Linder (1985b)	X	X	
TRA	Halford (1983)	X	X	
TRA	Halford (1987)	X		
TRA	Halford and Markham (1978)	X	X	
TRA	Halford and Markham (1984)		X	
TRA	Halford and Millard (1978)	X		
TRA	Halford et al. (1981)	X	X	
TRA	Halford et al. (1982a)	X	X	
TRA	Halford et al. (1982b)	X	X	
INEEL	Hironaka et al. (1983)	X		
INEEL	Howe and Flake (1988)	X	X	
INEEL	Howe and Flake (1989a)	X	X	
INEEL	Howe and Flake (1989b)	X	X	X
TRA	Ibrahim and Culp (1989)	X	X	
RWMC/TSA, RWMC/SDA	Janke and Arthur (1985)	X	X	
INEEL	Johnson and Anderson (1984)	X	X	
INEEL	Knick (1990)	X	X	X
RWMC/SDA	Koehler and Anderson (1991)	X	X	
TRA	Kuzo et al. (1984)	X	X	
INEEL	Laundre (1989a)	X	X	
INEEL	Laundre (1989b)	X	X	
INEEL	Linder and Sehman (1977)	X		
INEEL	MacCracken and Hansen (1982a)	X		

Table D1-7-1. (continued).

Facility or Waste Management Area	Publication	Problem Formulation	Analysis	Risk Characterization
INEEL	MacCracken and Hansen (1982b)	X		
INEEL	MacCracken and Hansen (1984)	X		
INEEL	Markham (1974)	X	X	
RWMC/SDA	Markham (1978)	X	X	
TRA, RWMC, ARA, TAN, LOFT, NRF, INTEC, EBR-II	Markham and Halford (1982)	X	X	X
INTEC	Markham and Halford (1985)	X	X	
INEEL	Markham and Trost (1986)	X	X	
RWMC/SDA	Markham et al. (1978)	X	X	
INTEC, INEEL	Markham et al. (1979)		X	
INTEC, INEEL	Markham et al. (1980a)		X	
INEEL	Markham et al. (1980b)		X	
INTEC	Markham et al. (1982)		X	
INTEC	Markham et al. (1983)	X		
TRA	Markham et al. (1988)		X	
INEEL	Millard et al. (1983)	X	X	
TRA	Millard et al. (1990)	X	X	X
INEEL	Mullican (1986)	X		
RWMC	Mullican and Keller (1986)	X	X	
INEEL	Mullican and Keller (1987)	X		
INEEL	Reynolds (1979)	X		
INEEL	Reynolds (1980)	X		
INEEL	Reynolds (1981)	X	X	X
RWMC/SDA	Reynolds (1990)	X		
RWMC/SDA	Reynolds and Fraley (1989)	X		
INEEL	Reynolds and Laundre (1988)	X		
INEEL	Reynolds and Rich (1978)	X	X	X
INEEL	Reynolds and Trost (1979)	X		X
INEEL	Reynolds and Trost (1981)	X		X
INEEL	Reynolds and Wakkinen (1987)	X		
INEEL	Reynolds et al. (1986)	X		

Table D1-7-1. (continued).

Facility or Waste Management Area	Publication	Problem Formulation	Analysis	Risk Characterization
	Shumar et al. (1982)			
INEEL	Stafford et al. (1986)	X		
INEEL	Stauber et al. (1980)			X
INEEL	Watson (1984)	X	X	
INEEL	Watson (1986)	X	X	
INEEL	Woodruff and Keller (1982)		X	
INEEL	Youtie et al. (1987)	X		

Table D1-7-2. Radioactive contamination of various environmental media near the INTEC at the INEEL. Data are ranges unless otherwise noted.

Medium	Nuclides	Levels (pCi/g)	References
Soil			
Area surrounding INTEC, < 10–cm depth	Be-7	ND[a] to 0.81	Unpublished data from RESL, 1971 to 1989
	Mn-54	ND to 0.25	
	Co-60	ND to 5.7	
	Sr-90	ND to 27	
	Nb-95	ND to 0.20	
	Zr-95	ND to 0.20	
	Ru-106	ND to 0.57	
	Sb-105	ND to 0.81	
	Cs-134	ND to 0.59	
	Cs-137	ND to 54	
	Ce-144	ND to 0.89	
	Pu-238	ND to 0.37	
	Pu-239[b]	ND to 0.073	
	Am-241	ND to 0.035	
	Other γ[f]	ND	
Vegetation			
Sagebrush and grasses < 31 km from INTEC	I-129[d]	1.8×10^{-5} to 1.4×10^{-3}	McGiff (1985)
Pronghorn rumen contents ≤ 10 km from INTEC	Co-60	ND to 0.43	Markham et al. (1982)
	Zr-95	ND to 1.0	
	Nb-95	ND to 1.8	
	Ru-106	ND to 54	
	Sb-125	ND to 4.1	
	Cs-134	ND to 1.1	
	Cs-137	ND to 24	
	Ba-140	ND to 0.18	
	La-140	ND to 0.18	
	Ce-141	ND to 0.97	
	Ce-144	ND to 2.2	
	Eu-154	ND to 0.43	
	Other γ[f]	ND	
Small Mammals			
Rabbit thyroids < 30 km from INTEC	I-129[d]	ND to 9.1×10^{-4}	Fraley et al. (1982)

Table D1-7-2. (continued).

Medium	Nuclides	Levels (pCi/g)	References
Game Mammals			
Pronghorn lungs <10 km from INTEC	Pu-238	0.00062[e]	Markham et al. (1976)
	Pu-239[b]	0.00060[e]	Markham et al. (1979)
Pronghorn muscle and liver ≤10 km from INTEC	Co-60	ND to 0.10	Markham et al. (1976)
	Zn-65	ND to 0.035	Markham et al. (1982)
	Cs-134	ND to 0.15	
	Cs-137	ND to 2.6	
	Pu-238	ND to 2.0	
	Other γ[f]	ND	
Pronghorn bone ash ≤10 km from INTEC	Sr-90	1.4 to 46	Markham et al. (1976)
	Pu-238	ND to 0.017	Markham et al. (1979)
Upland Game Birds[f]			
Mourning dove GI	Cr-51	ND to 27	Markham and Halford (1982)
	Co-60	ND to 1.2	
	Nb-95	ND to 0.59	
	Ru-106	ND to 54	
	Sb-125	ND to 4.9	
	I-131	ND to 15	
	Cs-134	ND to 9.5	
	Cs-137	ND to 140	
	Other γ[f]	ND	
Mourning dove muscle	Cr-51	ND to 0.49	Markham and Halford (1982)
	Co-60	ND to 8.4	
	Cs-134	ND to 0.70	
	Cs-137	ND to 12	
	Other γ[f]	ND	
Sage grouse GI at TRA and INTEC	Cr-51	ND to 540	Connelly and Markham (1983)
	Mn-54	ND to 0.70	
	Co-58	ND to 0.10	
	Co-60	ND to 25	
	Zn-65	ND to 13	
	Se-75	ND to 4.6	
	Nb-95	ND to 1.8	
	Zr-84	ND to 1.1	
	Ru-103	ND to 0.89	
	Cs-134	ND to 27	
	Cs-137	ND to 110	
	La-140	ND to 0.59	
	Ce-141	ND to 2.2	
	Ce-144	ND to 7.0	
	Hg-203	ND to 0.59	
	Other γ[f]	ND	

Table D1-7-2. (continued).

Medium	Nuclides	Levels (pCi/g)	References
Upland Game Birds			
Sage grouse muscle at TRA and INTEC	Na-24	ND to 3.8	Connelly and Markham (1983)
	Mn-54	ND to 0.30	
	Co-60	ND to 1.9	
	Zn-65	ND to 1.5	
	Se-75	ND to 1.4	
	Nb-95	ND to 0.20	
	Ru-103	ND to 0.41	
	Cs-134	ND to 5.7	
	Cs-137	ND to 30	
	Ba-140	ND to 2.7	
	Hg-203	ND to 0.49	
	Other γ[f]	ND	
Waterfowl[f]			
INTEC waste ponds	Co-60	0.57 to 18	Morris et al. (unpublished data through 1989)
	Nb-95	0.84 to 2.6	
	Zr-95	0.70 to 0.81	
	Ru-106	3.8 to 4.3	
	Cs-134	0.51 to 2.6	
	Cs-137	0.32 to 38	
	Ce-144	ND to 3.0[g]	
	Other γ[f]	ND	
Fish			
Rainbow trout in Big Lost River near INTEC	Cs-137	ND to 2.4	Overton and Johnson (1976)

a. Not detected. Detection limits varied between studies.

b. Assumed to include both Pu-239 and Pu-240.

c. Samples were analyzed by gamma scan.

d. Atoms ^{129}I (atoms $^{127}I)^{-1}$.

e. Maximum.

f. More recent data are available for radionuclide concentrations in mourning dove and waterfowl. These are published in the INEEL Site Environmental Report for 1996 and previous years. This information will be included in the final evaluation presented in the OU 10-04 ERA.

g. Detected in a single sample.

concentration is 0.28 times the background presented in Rood et al. (1995) of 0.26 pCi/g (for grab samples 95%/99% UTL). The maximum soil concentration of Pu-238 in soil near INTEC was 0.37 pCi/g, which is approximately 0.26% of that found in SDA surface soils ([1.4 pCi/g]) and 16.8 times the maximum background (0.022 pCi/g) reported in Table C-1.1 of VanHorn et al. (1995). The maximum soil concentration is 30.8 times the background presented in Rood et al. (1995) of 0.012 pCi/g (for grab samples 95%/99% UTL).

The nuclide I-129 has been of particular interest at INTEC because it is a result of the fuel dissolution process and is transported relatively long distances from the plant by atmospheric processes. Studies of vegetation (McGiff 1985) and rabbit thyroids (Fraley and Bowman 1982) have identified I-129 contamination in these media greater than background out to 30 km from the INTEC. Iodine-129 has been detected above background concentrations in pronghorn tissues site-wide (Markham 1974) and as far offsite as Craters of the Moon National Monument and Monida Pass (Markham et al. 1983).

D1-7-1.1.1 Trends

Cesium-137 is found in above background concentrations out to a distance of greater than 2 km from the stack at INTEC (see Appendix C, Figure C-I.3 [VanHorn et al. 1995]). Background concentrations were observed beyond about 10 km. No data are available for the intermediate distances so the extent of the plume cannot be precisely determined. There is no evidence for a change in the extent of the soil contamination plume but concentrations in the 0 to 5–cm depth decreased significantly between 1973 and 1979. During the same period, concentrations in the 5 to 10–cm depth have increased, arguing for downward migration of soil contamination. Sitewide, concentrations of Cs-137 in the lower soil depth are about 18% of those in the surface soils.

With the exception of one data point, Pu-239/240 is found in background concentrations at all distances from the stack at INTEC (see Appendix C, Figure C-I.4 [VanHorn et al. 1995]). A single, above background concentration was observed at 1.7 km from the stack in 1989, the last sampling from the INTEC grid in this data set. All other samples, including those from greater distances, were at background concentrations. This single point is insufficient evidence to argue for an increase in plume size. LMITCO Environmental Monitoring took over responsibility for on-site soil sampling in 1994 and sampled INTEC in 1996. Those data will be included when this evaluation is finalized in the OU 10-04 ERA. Concentrations of Pu-239/240 remained constant in both soil depths between 1982 and 1989, indicating little vertical migration of plutonium. Sitewide, concentrations of Pu-239/240 in the lower soil depth are negligible compared to those in the surface soils.

Because I-129 is produced in the calcining process, it is reasonable to expect I-129 concentrations in the environment to increase in magnitude and extent when the calcining process is in operation. However, because of the long half-life of I-129 (1.6×10^7 y) and the strong affinity for some chemical forms of iodine for organic fractions of the soil, it may not be reasonable to expect decreases in contamination magnitude or extent when calcining stops. Studies are currently under way to determine whether these arguments are valid. Similar arguments may hold true for some transuranic elements.

D1-7-1.1.2 Data Gaps

Significant data gaps exist in the INTEC related data. Limited vegetation and small mammal data are available, particularly for the transuranics and gamma-emitting radionuclides. These data are important because these two groups serve as the base of the herbivore and carnivore food chains and because small mammals include one of INEEL's species of special concern (the pygmy rabbit). Raptors, other birds, and bats, all of which include species of special concern species, are not represented in the

INTEC data. On the other hand, the data that are important for human food chain exposure, the game species, are well represented. Soil samples were not collected between about 2 to 10 km from the stack and these samples are necessary to determine the extent of the contamination plume at INTEC.

D1-7-1.2 Test Reactor Area

The contamination of environmental media near TRA or WAG 2 has been intensively studied. Gamma-emitting and transuranic radionuclides have been detected in soils; sediment, vegetation, and water from the radioactive waste percolation pond; small mammals; coyote feces; raptors; upland game birds; waterfowl; and barn swallows. Almost all studies at the TRA have been focused on the currently inactive, radioactive waste percolation ponds. The contaminant concentrations found at this site are summarized in Table D1-7-3.

The sediments of the radioactive waste percolation ponds at TRA are the most contaminated soils in the studies reported here. The mean concentration of Cs-137 in barn swallow nests made with TRA pond sediments was 2,500 pCi/g. The mean concentration of Pu-239,240 in TRA pond sediments was 43 pCi/g. However, as noted above, comparison of these values with values for terrestrial soils may be invalid. The maximum ^{137}Cs and Pu-239, 240 concentrations found in the RESL surveys of the area surrounding the TRA were 220 and 0.065 pCi g^{-1}, respectively. For ^{137}Cs, this value is 32% of the maximum soil concentration found at SL-1 (Table C-I.4) and 75 times background (Table C-I.1) (Tables found in Appendix C—VanHorn et al. 1995). For Pu-239/240, this represents 0.1% of the maximum at the SDA (Table C-I.3) and 73% of background (Table C-I.1).

D1-7-1.2.1 Trends

Cesium-137 was found in above background concentrations in surface soils out to 750, 280, and 600 m in 1976, 1983, and 1990, respectively (see Appendix C, Figure C-I.9 [VanHorn et al. 1995]). Thus, there is no evidence for a regular pattern of expansion or contraction of the plume size over the 14 years studied. There was a statistically significant increase in average Cs-137 concentration within the 5 to 10–cm soil layer between 1976 and 1983, indicating that downward migration was occurring.

The surface soil concentration of Pu-239/240 was determined in only one year (1976) and is therefore insufficient to determine temporal trends. Above background concentrations were found out to 28 m from the fence (Figure C-I.10). LMITCO Environmental Monitoring took over responsibility for on-site soil sampling in 1994 and sampled TRA in 1997. These data will be included when this evaluation is finalized in the OU 10-04 ERA.

Few data sets allow estimation of spatial trends in media other than soil. Craig et al. (1979) found decreasing concentrations of radioactivity in raptors with distance from the TRA, probably due to decreasing contamination of the prey. They estimated that the maximum distance at which radionuclides from the TRA/INTEC complex could be detected in nestling raptors was 3.5 km.

D1-7-1.2.2 Data Gaps

The data set from the TRA is the most complete set in this review with respect to the environmental media covered. In spite of this, a significant data gap exists. No data are available in these studies for contamination of terrestrial vegetation near TRA. Thus, no data are available for the base of the terrestrial food chain.

Table D1-7-3. Radioactive contamination of various environmental media from TRA at INEEL. Data are ranges unless otherwise noted.

Medium or Location	Nuclides	Levels (pCi/g)	References
Soil			
Radioactive waste pond sediments	Pu-238	13 ± 5.4[a]	Kuzo et al. (1987) Markham et al. (1988)
	Pu-239[b]	3.2 ± 2.2[a]	
	Am-241	2.4 ± 1.1[a]	
	Cm-242	0.54 ± 0.27[a]	
	Cm-244	4.1 ± 1.1[a]	
Radioactive waste pond sediments	Pu-238	41 ± 4.3[a]	Ibrahim and Culp (1989)
	Pu-239[b]	43 ± 4.9[a]	
Barn swallow nests made with radioactive waste pond sediment	Sc-46	1.4 ± 0.95[a]	Millard et al. (1990)
	Cr-51	6,200 ± 12,000[a]	
	Mn-54	10 ± 10[a]	
	Co-57	3.5 ± 3.8[a]	
	Co-58	9.2 ± 8.4[a]	
	Fe-59	2.4 ± 4.6[a]	
	Co-60	840 ± 950[a]	
	Zn-65	49 ± 51[a]	
	Zr-95	6.5 ± 9.5[a]	
	Ru-103	1.4 ± 0.95[a]	
	Ru-106	10 ± 27[a]	
	^{131}I-131	23 ± 35[a]	
	Cs-134	370 ± 350[a]	
	Cs-137	2,500 ± 2,500[a]	
	Ba-140	32 ± 54[a]	
	Ce-141	32 ± 38[a]	
	Ce-144	110 ± 140[a]	
	Hf-181	10 ± 14[a]	
	Other γ[f]	ND[d]	
Ant mounds at the radioactive waste pond	Co-60	3.2 to 49[e]	Blom et al. (1991)
	Cs-137	12 to 270[e]	
Area surrounding TRA, < 10–cm depth	Be-7	ND to 0.76	Unpublished data from RESL, 1971 to 1990
	Mn-54	ND to 0.059	
	Co-60	ND to 68	
	Sr-90	ND to 5.7	
	Nb-95	ND to 0.089	
	Zr-95	ND to 0.081	
	Sb-125	ND to 0.22	
	Cs-134	ND to 2.7	
	Cs-137	ND to 220	
	Ce-141	ND to 0.041	

Table D1-7-3. (continued).

Medium or Location	Nuclides	Levels (pCi/g)	References
Soil (continued)			
Area surrounding TRA, < 10–cm depth	Ce-144	ND to 1.0	
	Eu-152	ND to 0.70	
	Eu-155	ND to 0.11	
	Pu-238	ND to 0.016	
	Pu-239[b]	ND to 0.065	
	Am-241	ND to 0.016	
	Other γ[f]	ND	
Water			
Radioactive waste pond filtered water	Pu-238	0.0018 ± 0.00022[a]	Kuzo et al. (1987) Markham et al. (1988)
	Pu-239[b]	0.00035 ± 0.00049[a]	
	Am-241	0.0012 ± 0.00035[a]	
	Cm-242	0.0013 ± 0.00049[a]	
	Cm-244	0.0020 ± 0.00060[a]	
Radioactive waste pond	Pu-238	0.00081[f]	Ibrahim and Culp (1989)
	Pu-239[b]	0.00070[f]	
Vegetation			
Radioactive waste pond periphyton	Pu-238	410 ± 84[a]	Kuzo et al. (1987) Markham et al. (1988)
	Pu-239[b]	140 ± 43[a]	
	Am-241	110 ± 24[a]	
	Cm-242	30 ± 8.1[a]	
	Cm-244	180 ± 54[a]	
Radioactive waste pond plankton	Pu-238	14 ± 12[a]	Kuzo et al. (1987) Markham et al. (1988)
	Pu-239[b]	9.5 ± 20[a]	
	Am-241	8.1 ± 7.8[a]	
	Cm-242	3.2 ± 0.81[a]	
	Cm-244	11 ± 6.5[a]	
Radioactive waste pond plankton	Pu-238	130 ± 46[a]	Ibrahim and Culp (1989)
	Pu-239[b]	150 ± 49[a]	
Small Mammals			
Internal contamination from radioactive waste pond basin	Pu-238	ND to 0.14	Halford (1987)
	Pu-239[b]	ND to 0.10	
	Am-241	ND to 0.043	
	Cm-242	ND to 0.059	
	Cm-244	ND to 0.062	
External contamination from radioactive waste pond basin (gut and hide)	Pu-238	ND to 5.9	Halford (1987)
	Pu-239[b]	ND to 2.3	
	Am-241	ND to 1.6	
	Cm-242	ND to 0.030	
	Cm-244	ND to 1.8	

Table D1-7-3. (continued).

Medium or Location	Nuclides	Levels (pCi/g)	References
Small Mammals (continued)			
Radioactive waste pond basin	Cr-51	700[g]	Halford and Markham (1978)
	Co-60	320[g]	
	Zn-65	73[g]	
	Se-75	25[g]	
	Nb-95	ND to 15	
	I-131	73[g]	
	Cs-134	30[g]	
	Cs-137	270[g]	
	La-140	17[g]	
	Ce-141	ND to 38	
	Ce-144	ND to 26	
	Other γ[f]	ND	
Predatory Mammals			
Coyote feces from radioactive waste pond perimeter	Mn-54	ND to 120	Arthur and Markham (1982)
	Co-57	ND to 0.51	
	Co-60	0.59 to 150	
	Zn-65	ND to 3.8	
	Sr-90	2.7 to 22	
	Nb-95	ND to 11	
	Zr-95	ND to 9.5	
	Ru-103	ND to 1.1	
	Cs-134	0.59 to 17	
	Cs-137	ND to 270	
	Ce-144	ND to 35	
	Pu-238	ND to 0.073	
	Pu[b]-239	ND to 3.0	
	Am-241	0.0041 to 2.3	
	Cm-242	ND to 0.030	
	Cm-244	ND to 0.026	
	Other γ[f]	ND	
Raptors			
Kestrel	Many γ[h]	0.30 to 43	Craig et al. (1979)
Long-eared owl	Cs-137	ND to 0.41	Craig et al. (1979)
	Other γ[f]	ND	
Marsh Hawk	Many γ[h]	35 to 86	Craig et al. (1979)

Table D1-7-3. (continued).

Medium or Location	Nuclides	Levels (pCi/g)	References
Upland Game Birds[i]			
Mourning dove GI	Cr-51	ND to 2,600	Markham and Halford (1982)
	Co-60	ND to 230	
	Mn-54	ND to 8.6	
	Co-57	ND to 0.30	
	Co-58	ND to 0.49	
	Zn-65	ND to 22	
	Se-75	ND to 11	
	Nb-95	ND to 46	
	Zr-95	ND to 38	
	Ru-103	ND to 0.89	
	Sb-125	ND to 4.9	
	I-131	ND to 86	
	Cs-134	ND to 41	
	Cs-137	ND to 430	
	Ba-140	ND to 4.9	
	La-140	ND to 3.0	
	Ce-141	ND to 38	
	Ce-144	ND to 68	
	Hf-181	ND to 17	
	Other γ[f]	ND	
Mourning dove muscle	Cr-51	ND to 140	Markham and Halford (1982)
	Co-60	ND to 2.2	
	Se-75	ND to 6.5	
	Nb-95	ND to 0.20	
	I-131	ND to 1.8	
	Cs-132	ND to 89	
	Cs-134	ND to 19	
	Cs-137	ND to 7.0	
	Other γ[f]	ND	
Sage grouse GI at TRA and INTEC	Cr-51	ND to 540	Connelly and Markham (1983)
	Mn-54	ND to 0.70	
	Co-58	ND to 0.10	
	Co-60	ND to 25	
	Zn-65	ND to 13	
	Se-75	ND to 4.6	
	Nb-95	ND to 1.8	
	Zr-95	ND to 1.1	
	Ru-103	ND to 0.89	
	Cs-134	ND to 27	
	Cs-137	ND to 110	
	La-140	ND to 0.59	
	Ce-141	ND to 2.2	
	Ce-144	ND to 7.0	
	Hg-203	ND to 0.59	
	Other γ[f]	ND	

Table D1-7-3. (continued).

Medium or Location	Nuclides	Levels (pCi/g)	References
Upland Game Birds[i] (continued)			
Sage grouse muscle at TRA and INTEC	Na-24	ND to 3.8	Connelly and Markham (1983)
	Mn-54	ND to 0.30	
	Co-60	ND to 1.9	
	Zn-65	ND to 1.5	
	Se-75	ND to 1.4	
	Nb-95	ND to 0.20	
	Ru-103	ND to 0.41	
	Cs-134	ND to 5.7	
	Cs-137	ND to 30	
	Ba-140	ND to 2.7	
	Hg-203	ND to 0.49	
	Other γ[f]	ND	
Waterfowl[i]			
TRA chemical waste ponds (whole body)	Cs-137	0.19 to 0.62	Morris et al. (unpublished 1989)
	Au-198	3.0[l]	
	Other γ[f]	ND	
TRA radioactive waste ponds (muscle, skin, liver, gut feathers)	Na-24	ND to 73	Halford et al. (1981)
	Sc-46	ND to 380	
	Cr-51	130,000[g]	
	Mn-54	ND to 350	
	Co-57	ND to 120	
	Co-58	1,700[g]	
	Fe-59	ND to 270	
	Co-60	7,000[g]	
	Zn-65	1,500[g]	
	Se-75	590[g]	
	Nb-95	ND to 6,500	
	Zr-95	ND to 6,800	
	Ru-103	ND to 3,800	
	Ru-106	ND to 59	
	Ag-110m	ND to 89	
	Sb-124	ND to 3.0	
	I-131	2100[g]	
	Te-132	81[g]	
	Cs-134	1,200[g]	
	Cs-136	ND to 17	
	Cs-137	5,400[g]	
	Ba-140	ND to 12,000	
	La-140	5,900[g]	
	Ce-141	8,100[g]	
	Ce-144	6800[g]	
	Nd-147	ND to 3,000	
	Eu-154	ND to 12	
	Hf-175	ND to 7.0	

Table D1-7-3. (continued).

Medium or Location	Nuclides	Levels (pCi/g)	References
Waterfowl (continued)			
	Hf-181	ND to 4900	
	Other γ^f	ND	
TRA radioactive waste ponds (muscle)	Cr-51	ND to 210	Halford et al. (1982)
	Co-58	ND to 65	
	Co-60	ND to 140	
	Zn-65	ND to 240	
	Se-75	ND to 320	
	I-131	ND to 300	
	Cs-134	ND to 920	
	Cs-137	ND to 4100	
	Other γ^k	ND	
TRA radioactive waste ponds (muscle)	I-129[k]	1.5×10^{-7} to 3.8×10^{-6}	Halford and Markham (1984)
TRA radioactive waste ponds (whole body)	Cr-51	8.6 to 260	Morris (1993)
	Mn-54	2.1 to 3.5	Morris et al. (unpublished data through 1989)
	Co-60	1.4 to 180	
	Zn-65	1.6 to 35	
	Se-75	3.0 to 18	
	Nb-95	ND to 2.5[j]	
	Ag-110m	ND to 2.7[j]	
	Sb-124	ND to 59jj	
	Cs-134	0.81 to 20	
	Cs-137	5.4 to 460	
	Ce-141	ND to 10[j]	
	Hf-181	ND to 3.2[j]	
	Hg-203	4.3 to 8.1	
	Other γ^f	ND	
TRA sewage disposal pond (muscle)	I-129[k]	2.8×10^{-7} to 4.6×10^{-6}	Halford and Markham (1984)
Other Birds			
Immature barn swallows near TRA	Na-24	32 ± 35^a	Millard et al. (1990)
	Cr-51	57 ± 57^a	
	Co-60	2.4 ± 1.3^a	
	Zn-65	22 ± 4.6^a	
	Se-75	5.9 ± 2.6^a	
	I-131	8.1 ± 13^a	
	Cs-134	3.2 ± 2.0^a	
	Cs-137	7.0 ± 4.6^a	
	Ba-140	5.9 ± 4.6^a	
	Other γ^f	ND	

Table D1-7-3. (continued).

Medium or Location	Nuclides	Levels (pCi/g)	References
Other Birds (continued)			
Immature barn swallows at TRA	Na-24	150 ± 150[a]	Millard et al. (1990)
	Cr-51	300 ± 350[a]	
	Co-60	21 ± 18[a]	
	Zn-65	240 ± 140[a]	
	Se-75	62 ± 38[a]	
	I-131	65 ± 41[a]	
	Cs-134	15 ± 10[a]	
	Cs-137	54 ± 41[a]	
	Ba-140	46 ± 35[a]	
	Other γ[c]	ND	
Mature barn swallows at TRA	Na-24	230 ± 190[a]	Millard et al. (1990)
	Cr-51	430 ± 260[a]	
	Co-60	41 ± 21[a]	
	Zn-65	160 ± 110[a]	
	Se-75	140 ± 100[a]	
	I-131	150 ± 130[a]	
	Cs-134	35 ± 27[a]	
	Cs-137	170 ± 160[a]	
	Ba-140	22 ± 21[a]	
	Other γ[c]	ND	

a. Mean ±1 standard deviation.

b. Assumed to include both Pu-239 and Pu-240.

c. Samples were analyzed by gamma scan.

d. Not detected. Detection limits varied between studies.

e. Range of geometric means.

f. Mean only. No error reported.

g. Maximum.

h. Combined results from many gamma-emitting radionuclides.

i. More recent data are available for radionuclide concentrations in mourning dove and waterfowl. These are published in the INEEL Site Environmental Report for 1996 and previous years. This information will be included in the final evaluation presented in the OU 10-04 ERA.

j. Detected in a single sample.

k. Is ratio of Atoms I-129/Atoms I-127.

The radioactive waste percolation pond has been the focus of most of the studies at TRA because it has probably been the most significant source of contamination. However, remediation activities have been completed for the pond, which has been replaced with a lined evaporation pond. Thus, the data currently available may not be applicable to future operations at TRA.

Studies of the waterfowl using the new pond are nearing completion. Studies of the terrestrial environment surrounding the pond will also be necessary to determine the potential impact of the new pond on radioactive contamination of the environment.

D1-7-1.2.3 Dose Reconstruction

The tissue data presented above was entered into spreadsheets for selected radionuclides and dose was calculated to receptors at WAGs 2 and 3. The calculations summarized below are discussed in more detail in Appendices D2 and D3 and are as presented in the IAEA (1994).

Equation 1 calculates the internal radiation dose estimates by assuming that the steady-state tissue concentration is equivalent to the steady-state concentration of radionuclides in reproductive organs.

$$EE_{\text{internal}} = \frac{TC \times ADE \times FA \times 3200\ dis/day - pCi}{6.24 \times 10^{9}\ MeV/g - Gy} \quad (1)$$

where

$EE_{(internal)soil/food}$ = internal radiation dose estimate (Gy/day)

TC = tissue concentration (pCi/g)

ADE = average decay energy per disintegration (MeV/dis)

FA = fraction of decay energy absorbed (unitless)

Assumptions used in the calculation of the ADE values were (a) for beta or alpha radiations from a radionuclide the FA was set equal to 1 (100%), and (b) for gamma the FA was set equal to 0.3 (30%). Only emissions with an intensity of 1% or greater were considered, and Auger and conversion electrons were not considered. The ADE values for radionuclides are included in Appendix D3 Attachment 1. The ADE values were calculated using Equation 2 (Kocher 1981).

$$ADE = \sum_{1}^{n} Y_i E_i \quad (2)$$

where

ADE = Average decay energy per disintegration (MeV/dis)

Y_i = Yield or intensity

E_i = Energy of radiation, for ß = average energy.

Alpha particles are comparatively heavy and have a double charge, they react strongly with matter producing large numbers of ions per unit length of their path. As a result they are not very penetrating and are usually not hazardous. When internally deposited in the tissue of an organism, however, alpha particles are often more damaging than most other types of radiations because comparatively large amounts of energy are deposited within a very small volume of tissue. (Schultz and Whicker, 1982). Therefore a quality factor of 20 was multiplied times each internal dose calculation to allow for the greater damage possible from internally deposited alpha contamination.

As discussed in more detail in Appendix D4, radiological injury is caused by absorption of energy in living tissue from the decay of radionuclides. As in the case of chemical toxicants, the dose of radiation absorbed by any individual organism is a function of its anatomy, physiology, ecology, and behavior as well as the physical properties of one radionuclides. Studies on the effects of radionuclides have shown that the rate of chronic exposure is more important than the total dose in assessing radiotoxicity (IAEA, 1992). The toxicity reference value (TRV) for all radionuclides and all animal species was 1 mGy/day, the chronic dose below which there does not appear to be changes observed in terrestrial animal populations (IAEA, 1992).

D1-7-1.2.3.1 Preliminary Evaluation. As shown in Table D1-7-4, sage grouse and mourning dove tissue contains some contamination as compared to background values (see Appendix C [VanHorn et al. 1995]). However, these values do not present a dose that is over the target value, with one exception: Na-24 (a short lived radionuclide) has been identified in both sage grouse and barn swallow tissue. The amount found in the sage grouse tissue was considered a possible laboratory contaminant (Connelly and Markham, 1983). It has also been identified in barn swallow tissue in 1990 (Millard et al. 1990). This will be evaluated further as part of the tasks identified in Appendix C2.

Barn swallows tissue concentration data was presented as the average concentration sampled. The dose to barn swallows calculated from data collected by Millard et al. (1990) is over the target value as shown in Table D1-7-4. Coyote fecal material measured by Arthur and Markham (1982) also exceeds the target value. Levels of radionuclides in coyote fecal material would not be an indicator of the coyote's dose, but an indicator of a dose to prey the coyote has ingested.

The next steps will be to compare this data to more recent unpublished data. Review the activities at these areas that may have reduced contamination to receptors. Evaluate the foodweb models based on this assessment and past information on contaminant levels.

Table D1-7-4. Preliminary evaluation of historic dose to receptors in the WAGs 2 and 3 areas.

Tissue concentration (pCi/g)	Am-241	Ba-140	Co-60	Cr-51	Cs-132	Cs-134	Cs-137	I-131	Na-24	Pu-239	Se-75
Sage grouse at TRA/INTEC	0.00E+00	0.00E+00	1.90E+00	0.00E+00	0.00E+00	5.70E+00	3.00E+01	0.00E+00	3.80E+12	0.00E+00	1.40E+00
Immature barn swallow (1)	0.00E+00	5.90E+00	2.40E+00	5.70E+01	0.00E+00	3.20E+00	7.00E+00	8.10E+00	3.20E+01	0.00E+00	5.90E+00
Immature barn swallow (2)	0.00E+00	4.60E+01	2.10E+01	3.00E+02	0.00E+00	1.50E+01	5.40E+01	6.50E+01	1.50E+02	0.00E+00	6.20E+01
Immature barn swallow	0.00E+00	2.20E+01	4.10E+01	4.30E+02	0.00E+00	3.50E+01	1.70E+02	1.50E+02	2.30E+02	0.00E+00	1.40E+02
Coyote (feces)	2.30E+00	0.00E+00	1.50E+02	0.00E+00	0.00E+00	1.70E+01	2.70E+02	0.00E+00	0.00E+00	3.00E+00	0.00E+00
Mourning dove at TRA	0.00E+00	2.70E+00	2.20E+00	1.40E+02	8.90E+01	1.90E+01	7.00E+00	1.80E+00	0.00E+00	0.00E+00	6.50E+00
Mourning dove at INTEC	0.00E+00	0.00E+00	8.40E+00	4.90E-01	0.00E+00	7.00E-01	1.20E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00

These are averages

Internal Dose (Gy/day)

Species	Am-241	Ba-140	Co-60	Cr-51	Cs-132	Cs-134	Cs-137	I-131	Na-24	Pu-239	Se-75
Sage grouse at TRA/INTEC	0.00E+00	0.00E+00	2.60E-06	0.00E+00	0.00E+00	1.05E-05	5.53E-05	0.00E+00	2.40E+07	0.00E+00	8.32E-08
Immature barn swallow (1)	0.00E+00	1.76E-05	3.28E-06	2.75E-07	0.00E+00	5.90E-06	1.29E-05	1.56E-05	2.02E-04	0.00E+00	3.51E-07
Immature barn swallow (2)	0.00E+00	1.37E-04	2.87E-05	1.45E-06	0.00E+00	2.77E-05	9.95E-05	1.25E-04	9.47E-04	0.00E+00	3.68E-06
Mature barn swallow	0.00E+00	6.57E-05	5.60E-05	2.08E-06	0.00E+00	6.46E-05	3.13E-04	2.88E-04	1.45E-03	0.00E+00	8.32E-06
Coyote	1.29E-04	0.00E+00	2.05E-04	0.00E+00	0.00E+00	3.14E-05	4.98E-04	0.00E+00	0.00E+00	1.58E-04	0.00E+00
Mourning dove at TRA	0.00E+00	8.06E-06	3.01E-06	6.76E-07	0.00E+00	3.51E-05	1.29E-05	3.46E-06	0.00E+00	0.00E+00	3.86E-07
Mourning dove at INTEC	0.00E+00	0.00E+00	1.15E-05	2.37E-09	0.00E+00	1.29E-06	2.21E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Hazard quotient (unitless)

Species	Am-241	Ba-140	Co-60	Cr-51	Cs-132	Cs-134	Cs-137	I-131	Na-34	Pu-239	Se-75	THI[a]
Sage grouse at TRA/INTEC	0.E+00	0.E+00	3.E-03	0.E+00	0.E+00	1.E-02	6.E-02	0.E+00	2.E+10	0.E+00	8.E-05	2.E+10
Immature barn swallow (1)	0.E+00	2.E-02	3.E-03	3.E-04	0.E+00	6.E-03	1.E-02	2.E-02	2.E-01	0.E+00	4.E-04	3.E-01
Immature barn swallow (2)	0.E+00	1.E-01	3.E-02	1.E-03	0.E+00	3.E-02	1.E-01	1.E-01	9.E-01	0.E+00	4.E-03	1.E+00
Mature barn swallow	0.E+00	7.E-02	6.E-02	2.E-03	0.E+00	6.E-02	3.E-01	3.E-01	1.E+00	0.E+00	8.E-03	2.E+00
Coyote	1.E-01	0.E+00	2.E-01	0.E+00	0.E+00	3.E-02	5.E-01	0.E+00	0.E+00	2.E-01	0.E+00	1.E+00
Mourning dove at TRA	0.E+00	8.E-03	3.E-03	7.E-04	0.E+00	4.E-02	1.E-02	3.E-03	0.E+00	0.E+00	4.E-04	6.E-02
Mourning dove at INTEC	0.E+00	0.E+00	1.E-02	2.E-06	0.E+00	1.E-03	2.E-02	0.E+00	0.E+00	0.E+00	0.E+00	3.E-02

a, THI = Total hazard index—Is the summation of hazard quotients from individual radionuclides by row.

D1-7-1.3 References

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Appendix D1
Attachment 8

INEEL Wildlife Spatial Data Analysis

CONTENTS

FIGURES

TABLES

Appendix D1
Attachment 8

INEEL Wildlife Spatial Data Analysis

D1-8-1. INTRODUCTION

The overall objectives of the OU 10-04 ERA include determination and documentation of adverse effects to ecological receptors on an INEEL-wide scale. Receptors that are generally representative of ecological resources, as well as T/E species and other species of concern will be evaluated as part of the assessment (see Appendix D-1 Attachment 3). Although the effects associated with exposure of protected species to contaminants are generally evaluated at an individual level, exposures for most wildlife species (e.g., game species) are more appropriately evaluated at the population level. A primary requirement for performing such evaluations is spatial and population data to support geographic information system (GIS) interpretation of species distribution and extent of contaminant exposure.

Four general data types are required for characterizing and interpreting the spatial relationship of receptors to sources of contamination including:

- Species distribution (which areas of the INEEL are used and/or inhabited)
- Contaminant extent and concentration
- Species density (number of individuals per unit area is required if impact analysis includes an estimate of the number of individual animals affected)
- Total INEEL population for each species of interest (only required for comparison of INEEL population to regional populations for impact analysis).

Species distribution data sets will be overlaid on contaminant extent and concentration data to estimate and interpret the extent of any contaminant specific risk indicated during the assessment exposure modeling.

D1-8-1.1 Geographic Information System (GIS) Map Construction

A three-step process was applied to develop example GIS interpretive maps to support evaluation of individual and population level risks:

1. INEEL specific wildlife studies and existing data sets were reviewed and those studies and/or data sets associated with wildlife distribution, density, or populations were identified. This step was generally focused on a selected group of wildlife species and based on draft assessment endpoints (Appendix D1 Attachment 3).

2. Data were extracted from the literature and converted to an ORACLE database to allow GIS interpretation. Existing data sets including INEEL breeding bird surveys (BBS) and wildlife distribution information already residing in the GIS system were also incorporated. Specific data parameters vary somewhat among data sets; however, general parameters include:

a. Species taxonomic and common name

b. Number of sightings or telemetry signal readings

c. Location of sighting(s) and/or telemetry reading(s)

d. Vegetation association or other habitat descriptors

e. Reference document citation

f. Study date.

Individual data sets are linked through a primary data set containing all INEEL species taxonomic and common names.

3. Data were combined with existing GIS vegetation, soil, and habitat data sets to produce draft spatial distribution and summary maps for several species of interest. The purpose of this step was to identify general distribution patterns and associate sightings and/or telemetry data with primary vegetation cover types. Because detailed habitat models and data are not currently available for most species, vegetation cover type will be used as a surrogate for general habitat features. Example GIS analyses have been conducted for several species including the mule deer (Figure D1-8-1). Figure D1-8-1 presents mule deer telemetry locations (preliminary data collected by Peek and Beaver [ESRF 1998]) overlaid on the INEEL vegetation map. The map demonstrates mule deer distribution across the southern half of the INEEL and results of GIS analyses used to identify the habitat types frequented by the radio-collared deer. The habitat types most commonly associated with mule deer telemetry locations are sagebrush steppe on- and off-lava. Based on these telemetry data, habitat use by mule deer is primarily confined to the southern half of the INEEL. However, no telemetry data have been collected in the northern portions of the INEEL. Consequently, northern areas of the INEEL have been eliminated from the calculation of total habitat for this example. Using these associations, the portion of total potential habitat is 145,210 ha (358,669 acres) or 63% of overall INEEL habitat shown on Figure D1-8-1.

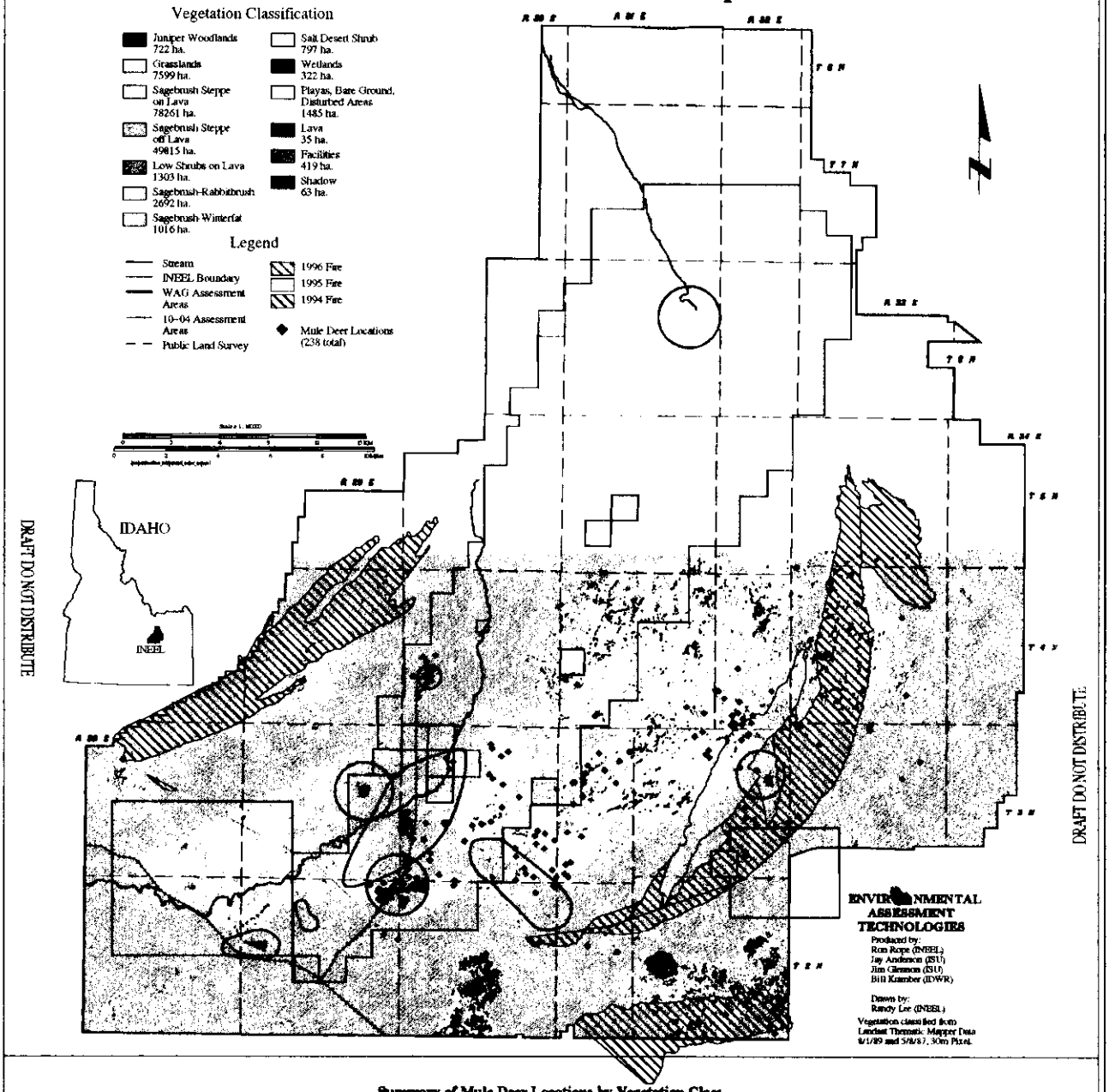
   This example also demonstrates the potential biases of GIS data sets, since mule deer are also regularly observed in northern areas of the INEEL. Those areas of habitat frequented by mule deer in the northern portions of the INEEL will be estimated for the ERA. Caution must be used in the literal interpretation of limited data sets.

D1-8-1.2 Species Exposure and Risk Analysis

Finalized distribution maps will be overlaid on GIS data sets depicting contaminant concentrations and spatial extent to characterize exposure and potential risk for species of interest. Preliminary delineation of contaminant spatial extent for the OU 10-04 ERA are depicted on Figure D1-8-1 and are used here as an example. Delineation of contaminant extent for the OU 10-04 ERA is discussed further in Subsection 3.6.2.1.2 of Appendix D1.

GIS analytical tools will then be applied to estimate the portion of each species population exposed based on vegetation/habitat associations within the assessment areas and the assumption that all areas of primary habitat are equally used. For example, the portion of total INEEL mule deer habitat (sagebrush steppe on- and off-lava) found in the preliminary assessment area encompassing WAG 2 is 1% (see Table D1-8-1).

ERA Draft Map



Summary of Mule Deer Locations by Vegetation Class

	No.	% of Total		No.	% of Total		No.	% of Total
Juniper Woodlands	2	0.83%	Salt Desert Shrub	0	0%	Old fields–disturbed seedings	1	0.42%
Basin Wildrye	0	0%	Sagebrush/Rabbitbrush	2	0.83%	Steppe Small Sagebrush (Steppe)	0	0%
Steppe	0	0%	Sage/Lowsage/Rabbitbrush On Lava	1	0.42%	Shadow	0	0%
Grassland	7	2.95%	Wetlands	0	0%	Unknown	2	0.83%
Sagebrush–Steppe Off Lava	40	16.9%	Playa-bare ground/gravel–borrow pits	1	0.42%	Agriculture	0	0%
Sagebrush–Steppe On Lava	177	74.7%	Old Lava	3	1.27%	Mountains	0	0%
Sagebrush/Winterfat	0	0%	New Lava/Basalt rubble	1	0.42%	Facilities	1	0.42%

Table D1-8-1. Summary of mule deer habitat for preliminary assessment areas.

WAG	Habitat (ha)	Habitat (acres)	% of Assessment Area	% of Total Habitat
1	N/A	N/A	N/A	N/A
2	875	2,162	87	<1
3	2,565	6,337	81	2
4	861	2,126	76	<1
5	1,733	4,280	93	1
6	147	363	94	<1
7	368	910	75	<1
8	106	263	63	<1
9	577	1,425	84	<1

The inference is that a small fraction of the mule deer population at the INEEL is potentially at risk as a consequence of exposure to contaminant levels associated with the WAG 2 assessment area. Mule deer habitat located inside other preliminary WAG assessment areas is also presented in Table D1-8-1. Both calculated values (i.e., home ranges) and weight of evidence (for instance, the concentrated use of the WAG 4 assessment area by mule deer) will be used to refine and characterize potential risks for species populations evaluated in the OU 10-04 ERA. The density of individual species within primary habitat types is required to estimate of number of individual animals at potential risk. In addition, density and population data for areas outside the INEEL would be required to interpret risk to INEEL populations in the context of regional impacts. Risk characterization in terms of individual animals and in a regional context is not currently planned for the OU 10-04 ERA.

D1-8-1.3 Data Limitations and Assumptions

Individual data sets that will be used in the OU 10-04 ERA analyses have specific limitations and will be presented in more detail in the problem formulation of the assessment. Some general limitations pertinent to the level and quality of assessment that can be supported by these data sets include:

- INEEL ecological data are not generally available in electronic or GIS compatible format. Most data sets created thus far have required data entry and/or alteration to create computer compatible files. Further data compilation will require substantial effort.

- Few long-term data sets exist (i.e., BBS, jackrabbit, raptor counts). Most data sets can be used to produce only rough estimates of resident or cyclic populations for many species.

- Census data are limited to a few species and the populations and activities of large animals are more often surveyed and more accurately estimated than those of small animals. Accurate location coordinates (i.e., telemetry or GPS data) are not available for most data sets.

- INEEL-wide distribution data have not been collected for most species. Validated habitat models are also not available for most species. Distributions for some species of interest must, therefore, be based primarily on vegetation associations and range maps of varying

scale and accuracy. Evaluations based on habitat associations have additional limitations and restrictions, which will be discussed in the OU 10-04 ERA.

- INEEL GIS base maps (i.e., vegetation and soils) have not been assessed for accuracy.

D1-8-1.4 References

ESRF, 1998, *Annual Technical Report to DOE-ID: Calendar Year 1997*, Environmental Science and Research Foundation, Inc., ESRF-027.

Appendix D1
Attachment 9

1997 OU 10-04 Ecological Sampling Data

LOCKHEED MARTIN

Lockheed Martin Idaho Technologies Company

INTERDEPARTMENTAL COMMUNICATION

Date:	May 27, 1998		
To:	Susan M. Barna	MS 3953	6-9382
From:	Donna R. Kirchner DRK	MS 3960	6-9873
Subject:	TRANSMITTAL OF RESULT TABLES FOR THE ECOLOGICAL STUDY AREA - ABIOTIC SAMPLES PROJECT - DRK-41-98		

Enclosed please find the following Result Tables for the Ecological Study Area – Abiotic Samples Project.

Inorganic

Result Tables

Ecological Study Area – Abiotic Samples – Inorganic Data (Method Validation Level A, table dated 5-27-98)

Ecological Study Area – Abiotic Samples – Inorganic Rinsate Data (Method Validation Level A, table dated 5-27-98)

Radionuclide

Result Table

Ecological Study Area – Abiotic Samples – Analysis Results for Radionuclide Data (Method Validation Level A, table dated 5-27-98)

Ecological Study Area – Abiotic Samples – Analysis Results for Radionuclide Rinsate Data (Method Validation Level A, table dated 5-27-98)

After reviewing the Ecological Study Area – Abiotic Samples Plan Table Number ERA-ABIOTIC, Revision 2.0, dated July 9, 1997, the following was noted:

Samples Planned But Not Collected

ESA01402FR
ESA01403FR
ESA01402LA
ESA01403LF
ESA01501FR
ESA01601FR

Samples Collected But Not Planned

None

Please review the enclosed tables carefully. If you have any questions, or would like any changes, please do not hesitate to contact me at 526-9873 or Lotus Notes DRK.

DRK

Enclosure

cc: (w/o Encl)
Tom J. Haney, (w/Encl), MS 3953
Mary W. Hudson, (w/Encl), MS 3960
Michelle Johnson, MS 3960
Ecological Study Area – Abiotic Samples Project File
Project File ESA0-01
Project File ESA0-02
Project File ESA0-03
Project File ESA0-04
Project File ESA0-05
Project File ESA0-06
Project File ESA0-07
Project File ESA0-08
Donna R. Kirchner File
File Code 6404

Status of Data Packages
Ecological Study Area - Abiotic Samples
July 1997
S. M. Barna

SDG Number	Packet No.	Analysis Type	Action Date	Action Taken
** Packet No.: ESA0-01				
ESA00601LA	ESA0-01	METALS - (TAL)	12/24/97	Received from SMO - FMG-595-97
ESA00601LA	ESA0-01	METALS - (TAL)	12/24/97	Enter Form 1's Only
ESA00601LA	ESA0-01	METALS - (TAL)	12/24/97	Validation "A" Req - WR#QI081
ESA00601LA	ESA0-01	METALS - (TAL)	12/24/97	Validation Due: 1-14-98
ESA00601LA	ESA0-01	METALS - (TAL)	01/15/98	Initial Data Entry
ESA00601LA	ESA0-01	METALS - (TAL)	01/27/98	Validation "A" Rec - DNT-32-98
ESA00601LA	ESA0-01	METALS - (TAL)	01/29/98	ERIS Upload(A) Req - DJ-23-98
ESA00601LA	ESA0-01	METALS - (TAL)	05/27/98	Result Table Produced
ESA00601LA	ESA0-01	METALS - (TAL)	05/27/98	Tables to SMB - DRK-41-98
** Packet No.: ESA0-02				
ESA00101LA	ESA0-02	METALS - (TAL)	12/16/97	Received from SMO - FMG-588-97
ESA00101LA	ESA0-02	METALS - (TAL)	12/16/97	Enter Form 1's Only
ESA00101LA	ESA0-02	METALS - (TAL)	12/16/97	Validation "A" Req - WR#QI076
ESA00101LA	ESA0-02	METALS - (TAL)	12/16/97	Validation Due: 1-6-98
ESA00101LA	ESA0-02	METALS - (TAL)	01/15/98	Initial Data Entry
ESA00101LA	ESA0-02	METALS - (TAL)	01/20/98	Validation "A" Rec - JDS-2-98
ESA00101LA	ESA0-02	METALS - (TAL)	01/29/98	ERIS Upload(A) Req - DJ-22-98
ESA00101LA	ESA0-02	METALS - (TAL)	05/27/98	Result Table Produced
ESA00101LA	ESA0-02	METALS - (TAL)	05/27/98	Tables to SMB - DRK-41-98
** Packet No.: ESA0-03				
ESA01401LA	ESA0-03	METALS - (TAL)	12/16/97	Received from SMO - FMG-588-97
ESA01401LA	ESA0-03	METALS - (TAL)	12/16/97	Enter Form 1's Only
ESA01401LA	ESA0-03	METALS - (TAL)	12/16/97	Validation "A" Req - WR#QI076
ESA01401LA	ESA0-03	METALS - (TAL)	12/16/97	Validation Due: 1-6-98
ESA01401LA	ESA0-03	METALS - (TAL)	01/15/98	Initial Data Entry
ESA01401LA	ESA0-03	METALS - (TAL)	01/19/98	Validation "A" Rec - JDS-1-98
ESA01401LA	ESA0-03	METALS - (TAL)	01/29/98	ERIS Upload(A) Req - DJ-21-98
ESA01401LA	ESA0-03	METALS - (TAL)	05/27/98	Result Table Produced
ESA01401LA	ESA0-03	METALS - (TAL)	05/27/98	Tables to SMB - DRK-41-98
** Packet No.: ESA0-04				
ESA00101FR	ESA0-04	RADS	11/13/97	Received from SMO - LBR-582-97
ESA00101FR	ESA0-04	RADS	11/13/97	Diskette Deliverable (9710035*.ASC)
ESA00101FR	ESA0-04	RADS	11/13/97	Diskette Problems - Incomplete
ESA00101FR	ESA0-04	RADS	11/13/97	Validation "A" Req - WR#ER017
ESA00101FR	ESA0-04	RADS	11/13/97	Validation Due: 12-3-97
ESA00101FR	ESA0-04	RADS	01/12/98	Download Diskette Deliverable
ESA00101FR	ESA0-04	RADS	01/14/98	Validation "A" Rec - BAM-125-97
ESA00101FR	ESA0-04	RADS	01/30/98	ERIS Upload(A) Req - DJ-28-98
ESA00101FR	ESA0-04	RADS	01/30/98	DBJ Notes to BAM - L&V Rpt Problem
ESA00101FR	ESA0-04	RADS	01/31/98	DBJ Notes to DRK - Data Pack Prob
ESA00101FR	ESA0-04	RADS	02/02/98	Resubmitted L&V Rpt - BAM-2-98
ESA00101FR	ESA0-04	RADS	05/27/98	Result Table Produced
ESA00101FR	ESA0-04	RADS	05/27/98	Tables to SMB - DRK-41-98
** Packet No.: ESA0-05				
ESA01301FR	ESA0-05	RADS	12/11/97	Received from SMO - FMG-574-97
ESA01301FR	ESA0-05	RADS	12/11/97	Diskette Deliverable (9710083*.ASC)
ESA01301FR	ESA0-05	RADS	12/11/97	Validation "A" Req - WR#ER023
ESA01301FR	ESA0-05	RADS	12/11/97	Validation Due: 12-31-97
ESA01301FR	ESA0-05	RADS	01/20/98	Download Diskette Deliverable
ESA01301FR	ESA0-05	RADS	01/21/98	Validation "A" Rec - DNT-20-98
ESA01301FR	ESA0-05	RADS	01/30/98	ERIS Upload(A) Req - DJ-27-98
ESA01301FR	ESA0-05	RADS	05/27/98	Result Table Produced
ESA01301FR	ESA0-05	RADS	05/27/98	Tables to SMB - DRK-41-98
** Packet No.: ESA0-06				
ESA00701LA	ESA0-06	METALS - (TAL)	01/08/98	Received from SMO - LBR-012-98
ESA00701LA	ESA0-06	METALS - (TAL)	01/08/98	Enter Form 1's Only
ESA00701LA	ESA0-06	METALS - (TAL)	01/08/98	Validation "A" Req - WR#QI083
ESA00701LA	ESA0-06	METALS - (TAL)	01/08/98	Validation Due: 1-27-98
ESA00701LA	ESA0-06	METALS - (TAL)	01/21/98	Initial Data Entry

Status of Data Packages
Ecological Study Area - Abiotic Samples
July 1997
S. M. Barna

SDG Number		Analysis Type	Action Date	Action Taken
ESA00701LA	ESA0-06	METALS - (TAL)	01/29/97	ERIS Upload(C) Req - DJ-25-98
ESA00701LA	ESA0-06	METALS - (TAL)	02/02/98	Validation "A" Rec - DNT-37-98
ESA00701LA	ESA0-06	METALS - (TAL)	02/05/98	ERIS Upload(A) Req - DJ-34-98
ESA00701LA	ESA0-06	METALS - (TAL)	02/09/98	DBJ Notes to MEE - Data Flags
ESA00701LA	ESA0-06	METALS - (TAL)	05/27/98	Result Table Produced
ESA00701LA	ESA0-06	METALS - (TAL)	05/27/98	Tables to SMB - DRK-41-98
** Packet No.: ESA0-07				
ESA01301LA	ESA0-07	METALS - (TAL)	01/08/98	Received from SMO - LBR-012-98
ESA01301LA	ESA0-07	METALS - (TAL)	01/08/98	Enter Form 1's Only
ESA01301LA	ESA0-07	METALS - (TAL)	01/08/98	Validation "A" Req - WR#QI083
ESA01301LA	ESA0-07	METALS - (TAL)	01/08/98	Validation Due: 1-27-98
ESA01301LA	ESA0-07	METALS - (TAL)	01/21/98	Initial Data Entry
ESA01301LA	ESA0-07	METALS - (TAL)	01/29/98	ERIS Upload(C) Req - DJ-26-98
ESA01301LA	ESA0-07	METALS - (TAL)	02/02/98	Validation "A" Rec - DNT-38-98
ESA01301LA	ESA0-07	METALS - (TAL)	02/05/98	ERIS Upload(A) Req - DJ-35-98
ESA01301LA	ESA0-07	METALS - (TAL)	02/09/98	DBJ Notes to MEE - Data Flags
ESA01301LA	ESA0-07	METALS - (TAL)	05/27/98	Result Table Produced
ESA01301LA	ESA0-07	METALS - (TAL)	05/27/98	Tables to SMB - DRK-41-98
** Packet No.: ESA0-08				
ESA00701C2	ESA0-08	CYANIDE	01/13/98	Received from SMO - LBR-035-98
ESA00701C2	ESA0-08	CYANIDE	01/13/98	Enter Form 1's Only
ESA00701C2	ESA0-08	CYANIDE	01/13/98	Validation "A" Req - WR#QI086
ESA00701C2	ESA0-08	CYANIDE	01/13/98	Validation Due: 2-1-98
ESA00701C2	ESA0-08	CYANIDE	01/21/98	Initial Data Entry
ESA00701C2	ESA0-08	CYANIDE	01/29/98	ERIS Upload(C) Req - DJ-24-98
ESA00701C2	ESA0-08	CYANIDE	02/04/98	Validation "A" Rec - DNT-41-98
ESA00701C2	ESA0-08	CYANIDE	02/05/98	DBJ Notes to DRK - Status of L&V?
'SA00701C2	ESA0-08	CYANIDE	02/09/98	DBJ Notes to MEE - Status of L&V
'SA00701C2	ESA0-08	CYANIDE	02/09/98	ERIS Upload(A) Req - DJ-39-98
'SA00701C2	ESA0-08	CYANIDE	05/27/98	Result Table Produced
'SA00701C2	ESA0-08	CYANIDE	05/27/98	Tables to SMB - DRK-41-98

IEDMS Journal Sample Number Listing
Ecological Study Area - Abiotic Samples
July 1997
S. M. Barna

Sample No.	SDG No.	Packet No.	Analysis	Lab Name	Date Received
ESA00101FR	ESA00101FR	ESA0-04	RADS	PARAGON ANALYTICS, INC.	11/13/97
ESA00101LA	ESA00101LA	ESA0-02	METALS - (TAL)	QST ENVIRONMENTAL	12/16/97
ESA00201FR	ESA00101FR	ESA0-04	RADS	PARAGON ANALYTICS, INC.	11/13/97
ESA00201LA	ESA00101LA	ESA0-02	METALS - (TAL)	QST ENVIRONMENTAL	12/16/97
ESA00301FR	ESA00101FR	ESA0-04	RADS	PARAGON ANALYTICS, INC.	11/13/97
ESA00301LA	ESA00101LA	ESA0-02	METALS - (TAL)	QST ENVIRONMENTAL	12/16/97
ESA00401FR	ESA00101FR	ESA0-04	RADS	PARAGON ANALYTICS, INC.	11/13/97
ESA00401LA	ESA00101LA	ESA0-02	METALS - (TAL)	QST ENVIRONMENTAL	12/16/97
ESA00501FR	ESA00101FR	ESA0-04	RADS	PARAGON ANALYTICS, INC.	11/13/97
ESA00501LA	ESA00101LA	ESA0-02	METALS - (TAL)	QST ENVIRONMENTAL	12/16/97
ESA00502FR	ESA00101FR	ESA0-04	RADS	PARAGON ANALYTICS, INC.	11/13/97
ESA00502LA	ESA00101LA	ESA0-02	METALS - (TAL)	QST ENVIRONMENTAL	12/16/97
ESA00601FR	ESA00101FR	ESA0-04	RADS	PARAGON ANALYTICS, INC.	11/13/97
ESA00601LA	ESA00601LA	ESA0-01	METALS - (TAL)	QST ENVIRONMENTAL	12/24/97
ESA00602FR	ESA00101FR	ESA0-04	RADS	PARAGON ANALYTICS, INC.	11/13/97
ESA00602LA	ESA00601LA	ESA0-01	METALS - (TAL)	QST ENVIRONMENTAL	12/24/97
ESA00701C2	ESA00701C2	ESA0-08	CYANIDE	QST ENVIRONMENTAL	01/08/98
ESA00701FR	ESA00101FR	ESA0-04	RADS	PARAGON ANALYTICS, INC.	11/13/97
ESA00701LA	ESA00701LA	ESA0-06	METALS - (TAL)	QST ENVIRONMENTAL	01/08/98
ESA00702C2	ESA00701C2	ESA0-08	CYANIDE	QST ENVIRONMENTAL	01/08/98
ESA00702FR	ESA00101FR	ESA0-04	RADS	PARAGON ANALYTICS, INC.	11/13/97
ESA00702LA	ESA00701LA	ESA0-06	METALS - (TAL)	QST ENVIRONMENTAL	01/08/98
ESA00801FR	ESA00101FR	ESA0-04	RADS	PARAGON ANALYTICS, INC.	11/13/97
ESA00801LA	ESA00101LA	ESA0-02	METALS - (TAL)	QST ENVIRONMENTAL	12/16/97
ESA00901FR	ESA00101FR	ESA0-04	RADS	PARAGON ANALYTICS, INC.	11/13/97
ESA00901LA	ESA00101LA	ESA0-02	METALS - (TAL)	QST ENVIRONMENTAL	12/16/97
ESA01001FR	ESA00101FR	ESA0-04	RADS	PARAGON ANALYTICS, INC.	11/13/97
ESA01001LA	ESA00101LA	ESA0-02	METALS - (TAL)	QST ENVIRONMENTAL	12/16/97
ESA01101FR	ESA00101FR	ESA0-04	RADS	PARAGON ANALYTICS, INC.	11/13/97
ESA01101LA	ESA00101LA	ESA0-02	METALS - (TAL)	QST ENVIRONMENTAL	12/16/97
ESA01201FR	ESA00101FR	ESA0-04	RADS	PARAGON ANALYTICS, INC.	11/13/97
ESA01201LA	ESA00101LA	ESA0-02	METALS - (TAL)	QST ENVIRONMENTAL	12/16/97
ESA01202FR	ESA00101FR	ESA0-04	RADS	PARAGON ANALYTICS, INC.	11/13/97
ESA01202LA	ESA00101LA	ESA0-02	METALS - (TAL)	QST ENVIRONMENTAL	12/16/97
ESA01301FR	ESA01301FR	ESA0-05	RADS	PARAGON ANALYTICS, INC.	12/11/97
ESA01301LA	ESA01301LA	ESA0-07	METALS - (TAL)	QST ENVIRONMENTAL	01/08/98
ESA01401LA	ESA01401LA	ESA0-03	METALS - (TAL)	QST ENVIRONMENTAL	12/16/97
ESA01403C2	ESA00701C2	ESA0-08	CYANIDE	QST ENVIRONMENTAL	01/08/98
ESA01403FR	ESA01301FR	ESA0-05	RADS	PARAGON ANALYTICS, INC.	12/11/97
ESA01403LA	ESA01301LA	ESA0-07	METALS - (TAL)	QST ENVIRONMENTAL	01/08/98

ECOLOGICAL STUDY AREA - ABIOTIC SAMPLES - INORGANIC DATA

AREA	CPP PLUME AREA ESA - #1	CPP PLUME AREA ESA - #2	CPP PLUME AREA ESA - #3	CPP PLUME AREA ESA - #4	CPP PLUME AREA ESA - #5
LOCATION	SURFACE SOIL	SURFACE SOIL	SURFACE SOIL	SURFACE SOIL	SURFACE SOIL
TYPE OF LOCATION	ESA00101LA	ESA00201LA	ESA00301LA	ESA00401LA	ESA00501LA
SAMPLE NUMBER	SOIL	SOIL	SOIL	SOIL	SOIL
MEDIA	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
UNITS	ESA00101LA	ESA00101LA	ESA00101LA	ESA00101LA	ESA00101LA
SDG NUMBER					
FIELD MEASUREMENT					
Depth (ft)	0-2	0-2	0-2	0-2	0-2
ANALYTES					
Aluminum	14200 *J	12400 *J	8020 *J	6490 *J	9660 *J
Antimony	5.2 U	3.9 U	4.6 U	4.2 U	4.8 U
Arsenic	2.9 NSJ	4.1 NSJ	3.3 NJ	4.4 NSJ	4.4 NSJ
Barium	246	230	191	139	199
Beryllium	0.78	0.77	0.56	0.44	0.58
Cadmium	0.75	0.71	0.67	0.42 U	0.61
Calcium	26800	23900	23100	10500	17300
Chromium	24.6 NJ	20.0 NJ	20.2 NJ	17.3 NJ	23.1 NJ
Cobalt	8.4	7.5	6.1	5.2	7.0
Copper	20.5	17.8	13.5	11.9	17.8
Cyanide	NR	NR	NR	NR	NR
Iron	18900	17200	13000	11600	14800
Lead	11.9	14.2	11.9	11.6	14.9
Magnesium	10300	8160	9590	5580	8480
Manganese	375	399	209	179	253
Mercury	0.04 J	0.03 BJ	0.03 BJ	0.03 B	0.04 BJ
Nickel	30.3	26.9	24.2	21.0	28.9
Potassium	2420 *J	2120 *J	1270 *J	1030 *J	1570 *J
Selenium	0.23 NUJ	0.26 NUJ	0.20 NUJ	0.24 NWUJ	0.25 NWUJ
Silver	0.52 U	0.39 U	0.46 U	0.42 U	0.48 U
Sodium	217 B	418	376 B	337 B	436 B
Thallium	0.18 U	0.21 U	0.16 U	0.19 U	0.20 U
Vanadium	25.1	22.4	20.8	19.6	22.3
Zinc	128 N*J	107 N*J	96.5 N*J	77.8 N*J	116 N*J
Tin					
Boron	6.2 J	9.2 J	6.4 J	4.8 J	5.2 J
Molybdenum	1.0 U	0.79 U	0.92 U	0.85 U	0.96 U
Strontium	72.3	64.8	59.9	35.3	55.0
% Solids	94.9	94.6	97.5	97.7	95.9
Total (Allowed) Hold Time[a]	65(180)d	65(180)d	65(180)d	54(180)d	54(180)d
Total (Allowed) Hold Time[b]	41(28)d*	41(28)d*	41(28)d*	30(28)d*	30(28)d*
Total (Allowed) Hold Time[c]	65(180)d	65(180)d	65(180)d	54(180)d	54(180)d
Total (Allowed) Hold Time[d]					

a. ICP
b. CVAAS
c. GFAAS
d. Cyanide

5-27-98

ECOLOGICAL STUDY AREA - ABIOTIC SAMPLES - INORGANIC DATA (Continued)

AREA	CPP PLUME AREA	IND. WASTE POND	IND. WASTE POND	IND. WASTE POND	IND. WASTE POND
LOCATION	ESA - #5	AQUATIC ESA #1	AQUATIC ESA #1	AQUATIC ESA #1	AQUATIC ESA #1
TYPE OF LOCATION	SURFACE SOIL	SEDIMENT	SEDIMENT	SURFACE WATER	SURFACE WATER
SAMPLE NUMBER	ESA00502LA	ESA00601LA	ESA00602LA	ESA00701C2	ESA00701LA
MEDIA	SOIL	SEDIMENT	SEDIMENT	WATER	WATER
UNITS	mg/kg	mg/kg	mg/kg	ug/L	ug/L
SDG NUMBER	ESA00101LA	ESA00601LA	ESA00601LA	ESA00701C2	ESA00701LA
FIELD MEASUREMENT					
Depth (ft)	0-2	0-2	0-2	0-2	0-2
ANALYTES					
Aluminum	10900 *J	7240	10700		395 *J
Antimony	5.1 U	6.3 U	7.7 U		50.0 U
Arsenic	4.3 NSJ	6.4 N*J	10.0 N*+J		4.7 B
Barium	233	155	214		55.7 B
Beryllium	0.76	0.51 U	0.62 B		4.0 U
Cadmium	0.67	0.79	4.6		5.0 U
Calcium	19900	39900	34600		51200
Chromium	25.8 NJ	277 *	4290 *		16.4
Cobalt	8.2	6.6	6.1 B		10.0 U
Copper	20.7	21.6	86.1		5.0 U
Cyanide	NR	NR	NR	10.0 U	NR
Iron	16300	12200	14800		373
Lead	15.2	12.2	29.1		6.3
Magnesium	9750	10600	20400		14200
Manganese	322	156	367		11.1 B
Mercury	0.05 J	0.14	1.8		0.20 U
Nickel	33.0	20.9	27.4		15.0 U
Potassium	1800 *J	1850	3130		6460
Selenium	0.26 NWUJ	0.28 R	1.2 NSJ		2.5 WUJ
Silver	0.51 U	1.1 BNJ	36.1 NJ		5.0 U
Sodium	472 B	416 B	670 B		22900
Thallium	0.20 U	0.25 U	0.42 WUJ		2.0 WUJ
Vanadium	25.0	25.6	49.6		10.0 U
Zinc	136 N*J	207	2060		22.4
Tin					
Boron	7.6 J	6.8 J	22.1 J		68.7
Molybdenum	1.0 U	2.5 J	2.2 J		10.0 U
Strontium	61.7	57.4 J	67.4 J		172
% Solids	96.0	75.9	52.1		
Total (Allowed) Hold Time[a]	54(180)d	29(180)d	29(180)d		26(180)d
Total (Allowed) Hold Time[b]	30(28)d*	27(28)d	27(28)d		26(28)d
Total (Allowed) Hold Time[c]	54(180)d	29(180)d	29(180)d		47(180)d
Total (Allowed) Hold Time[d]				14(14)d	

a. ICP
b. CVAAS
c. GFAAS
d. Cyanide

5-27-98

ECOLOGICAL STUDY AREA - ABIOTIC SAMPLES - INORGANIC DATA (Continued)

AREA	IND. WASTE POND	IND. WASTE POND	REF. STUDY AREA	REF. STUDY AREA	REF. STUDY AREA
LOCATION	AQUATIC ESA #1	AQUATIC ESA #1	RSA - #1	RSA - #2	RSA - #3
TYPE OF LOCATION	SURFACE WATER	SURFACE WATER	SURFACE SOIL	SURFACE SOIL	SURFACE SOIL
SAMPLE NUMBER	ESA00702C2	ESA00702LA	ESA00801LA	ESA00901LA	ESA01001LA
MEDIA	WATER	WATER	SOIL	SOIL	SOIL
UNITS	ug/L	ug/L	mg/kg	mg/kg	mg/kg
SDG NUMBER	ESA00701C2	ESA00701LA	ESA00101LA	ESA00101LA	ESA00101LA
FIELD MEASUREMENT					
Depth (ft)	0-2	0-2	0-2	0-2	0-2
ANALYTES					
Aluminum		415 *J	10600 *J	10500 *J	15900 *J
Antimony		50.0 U	5.2 U	5.3 U	5.0 U
Arsenic		2.5 WUJ	4.6 NSJ	6.3 NSJ	4.0 NSJ
Barium		45.9 B	175	203	238
Beryllium		4.0 U	0.56	0.56	0.85
Cadmium		5.0 U	0.52 U	0.53 U	0.53
Calcium		37700	57200	65900	22600
Chromium		19.0	13.7 NJ	13.3 NJ	17.5 NJ
Cobalt		10.0 U	6.6	6.5	7.9
Copper		5.0 U	13.2	13.3	18.4
Cyanide	10.0 U	NR	NR	NR	NR
Iron		595	12200	11700	16700
Lead		2.0 U	12.3	11.3	14.7
Magnesium		11600	10800	11000	8580
Manganese		12.5 B	377	391	506
Mercury		0.20 U	0.04	0.03 BJ	0.03 BJ
Nickel		15.0 U	16.9	15.6	20.3
Potassium		3520 B	2070 *J	1790 *J	3310 *J
Selenium		2.5 WUJ	0.22 NWUJ	0.22 NUJ	0.26 NWUJ
Silver		5.0 U	0.52 U	0.53 U	0.50 U
Sodium		17800	700	1920	971
Thallium		2.0 WUJ	0.18 U	0.18 U	0.24 B
Vanadium		10.0 U	18.9	22.4	22.6
Zinc		29.3	45.9 N*J	43.9 N*J	68.8 N*J
Tin					
Boron		50.0 U	9.5 J	17.3 J	13.6 J
Molybdenum		10.0 U	1.0 U	1.0 U	1.0 U
Strontium		134	93.2	126	66.5
% Solids			92.2	91.2	92.0
Total (Allowed) Hold Time[a]		26(180)d	49(180)d	53(180)d	53(180)d
Total (Allowed) Hold Time[b]		26(28)d	25(28)d	29(28)d*	29(28)d*
Total (Allowed) Hold Time[c]		47(180)d	49(180)d	53(180)d	53(180)d
Total (Allowed) Hold Time[d]	14(14)d				

a. ICP
b. CVAAS
c. GFAAS
d. Cyanide

5-27-98

ECOLOGICAL STUDY AREA - ABIOTIC SAMPLES - INORGANIC DATA (Continued)

AREA	REF. STUDY AREA	REF. STUDY AREA	REF. STUDY AREA
LOCATION	RSA - #4	RSA - #5	RSA - #5
TYPE OF LOCATION	SURFACE SOIL	SURFACE SOIL	SURFACE SOIL
SAMPLE NUMBER	ESA01101LA	ESA01201LA	ESA01202LA
MEDIA	SOIL	SOIL	SOIL
UNITS	mg/kg	mg/kg	mg/kg
SDG NUMBER	ESA00101LA	ESA00101LA	ESA00101LA
FIELD MEASUREMENT			
Depth (ft)	0-2	0-2	0-2
ANALYTES			
Aluminum	13600 *J	10500 *J	12900 *J
Antimony	4.0 U	5.4 U	4.4 U
Arsenic	3.8 NSJ	4.0 NSJ	3.9 NSJ
Barium	182	199	212
Beryllium	0.68	0.68	0.75
Cadmium	0.41	0.54 U	0.44 U
Calcium	31900	30000	31100
Chromium	16.4 NJ	13.1 NJ	15.3 NJ
Cobalt	7.6	6.9	7.5
Copper	14.8	13.6	15.5
Cyanide	NR	NR	NR
Iron	15500	11900	13900
Lead	14.6	13.3	13.9
Magnesium	9260	7480	8430
Manganese	481	453	495
Mercury	0.03 BJ	0.08	0.02 U
Nickel	17.8	16.6	18.9
Potassium	2580 *J	2220 *J	2640 *J
Selenium	0.27 NWUJ	0.25 NUJ	0.25 NUJ
Silver	0.40 U	0.54 U	0.44 U
Sodium	1320	901	891
Thallium	0.22 U	0.23 B	0.23 B
Vanadium	22.0	17.3	19.8
Zinc	56.6 N*J	48.5 N*J	56.9 N*J
Tin			
Boron	13.2 J	10.7 J	11.1 J
Molybdenum	.79 U	1.1 U	0.88 U
Strontium	71.2	67.0	72.3
% Solids	91.3	92.8	92.6
Total (Allowed) Hold Time[a]	54(180)d	49(180)d	49(180)d
Total (Allowed) Hold Time[b]	30(28)d*	25(28)d	25(28)d
Total (Allowed) Hold Time[c]	54(180)d	49(180)d	49(180)d
Total (Allowed) Hold Time[d]			

a. ICP
b. CVAAS
c. GFAAS
d. Cyanide

5-27-98

ECOLOGICAL STUDY AREA - ABIOTIC SAMPLES - INORGANIC RINSATE DATA

AREA	ESA	REF. STUDY AREA	REF. STUDY AREA	REF. STUDY AREA
LOCATION	QC	QC	QC	QC
TYPE OF LOCATION	RINSATE	RINSATE	RINSATE	RINSATE
SAMPLE NUMBER	ESA01301LA	ESA01401LA	ESA01403C2	ESA01403LA
MEDIA	WATER	WATER	WATER	WATER
UNITS	ug/L	ug/L	ug/L	ug/L
SDG NUMBER	ESA01301LA	ESA01401LA	ESA00701C2	ESA01301LA
ANALYTES				
Aluminum	50.0 U	50.0 U		50.0 U
Antimony	50.0 U	50.0 U		50.0 U
Arsenic	2.5 U	2.5 U		2.5 U
Barium	5.0 U	36.1 B		5.0 U
Beryllium	4.0 U	4.0 U		4.0 U
Cadmium	5.0 U	5.0 U		5.0 U
Calcium	48.9 B	162 B		25.0 U
Chromium	10.0 U	10.0 U		10.0 U
Cobalt	10.0 U	10.0 U		10.0 U
Copper	10.1 B	5.0 U		5.0 U
Cyanide	NR	NR	10.0 U	NR
Iron	10.9 B	36.5 B		10.0 U
Lead	2.6 BNJ	2.0 WUJ		2.0 NWUJ
Magnesium	75.0 U	75.0 U		75.0 U
Manganese	2.5 U	2.5 U		2.5 U
Mercury	0.20 U	0.10 U		0.20 U
Nickel	15.0 U	15.0 U		15.0 U
Potassium	700 U	600 U		700 U
Selenium	2.5 U	2.5 WUJ		2.5 U
Silver	5.0 U	5.0 U		5.0 U
Sodium	134 B	1500 B		100 U
Thallium	2.0 U	2.0 U		2.0 U
Vanadium	10.0 U	10.0 U		10.0 U
Zinc	8.8 B	61.5		5.9 B
Tin				
Boron	50.0 U	25.0 U		50.0 U
Molybdenum	10.0 U	10.0 U		10.0 U
Strontium	2.5 U	2.5 U		2.5 U
% Solids				
Total (Allowed) Hold Time[a]	27(180)d	10(180)d		27(180)d
Total (Allowed) Hold Time[b]	18(28)d	11(28)d		18(28)d
Total (Allowed) Hold Time[c]	28(180)d	10(180)d		28(180)d
Total (Allowed) Hold Time[d]			8(14)d	

a. ICP
b. CVAAS
c. GFAAS
d. Cyanide

5-27-98

ECOLOGICAL STUDY AREA - ABIOTIC SAMPLES - ANALYSIS RESULTS FOR RADIONUCLIDE DATA

AREA	CPP PLUME AREA		CPP PLUME AREA		CPP PLUME AREA		CPP PLUME AREA		CPP PLUME AREA	
LOCATION	ESA - #1		ESA - #2		ESA - #3		ESA - #4		ESA - #5	
TYPE OF LOCATION	SURFACE SOIL		SURFACE SOIL		SURFACE SOIL		SURFACE SOIL		SURFACE SOIL	
SAMPLE NUMBER	ESA00101FR		ESA00201FR		ESA00301FR		ESA00401FR		ESA00501FR	
MEDIA	SOIL	D	SOIL	D	SOIL	D	SOIL	D	SOIL	D
UNITS	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q
SDG NUMBER	ESA00101FR	F	ESA00101FR	F	ESA00101FR	F	ESA00101FR	F	ESA00101FR	F
FIELD MEASUREMENT										
Depth (ft)	0-2		0-2		0-2		0-2		0-2	
Gross Alpha	1.04E+01 ± 1.57E+00		7.51E+00 ± 1.24E+00		5.05E+00 ± 9.94E-01		7.46E+00 ± 9.48E-01		6.54E+00 ± 1.19E+00	
Gross Beta	1.10E+01 ± 1.27E+00		8.07E+00 ± 1.09E+00		5.22E+00 ± 1.02E+00		4.44E+00 ± 6.10E-01		6.01E+00 ± 1.04E+00	
Alpha Emitters										
Americium - 241	2.35E-02 ± 9.61E-03	UJ	3.87E-02 ± 9.96E-03		1.08E-02 ± 8.38E-03	U	1.05E-02 ± 6.75E-03	U	2.27E-02 ± 7.98E-03	UJ
Plutonium - 238	5.74E-02 ± 1.45E-02	UJ	5.66E-04 ± 4.57E-03	U	3.46E-03 ± 7.38E-03	U	2.22E-02 ± 1.03E-02	UJ	8.05E-02 ± 1.76E-02	J
Plutonium - 239	2.14E-02 ± 7.91E-03	J	1.87E-02 ± 7.50E-03	J	2.97E-03 ± 5.49E-03	U	1.24E-02 ± 6.07E-03	UJ	5.24E-03 ± 5.30E-03	U
Uranium - 234	9.83E-01 ± 8.45E-02		9.22E-01 ± 8.00E-02		1.05E+00 ± 8.75E-02		9.72E-01 ± 8.21E-02		1.14E+00 ± 9.39E-02	
Uranium - 235	3.57E-02 ± 1.21E-02		3.00E-02 ± 1.11E-02		4.59E-02 ± 1.35E-02		2.94E-02 ± 1.06E-02		4.77E-02 ± 1.40E-02	
Uranium - 238	9.03E-01 ± 7.93E-02		8.74E-01 ± 7.70E-02		1.07E+00 ± 8.87E-02		1.08E+00 ± 8.87E-02		9.49E-01 ± 8.22E-02	
Beta Emitters										
Strontium - 90	1.05E+00 ± 1.12E-01		5.17E-01 ± 7.06E-02		1.46E-01 ± 5.64E-02	UJ	1.43E-01 ± 5.62E-02	UJ	4.78E-02 ± 5.52E-02	U
Gamma Emitters										
Americium - 241	8.19E-02 ± 1.68E-01	U	5.17E-02 ± 5.25E-02	U	1.40E-01 ± 1.71E-01	U	1.88E-01 ± 1.25E-01	U	3.09E-02 ± 1.53E-01	U
Antimony - 125	-3.13E-02 ± 7.14E-02	U	-3.42E-02 ± 4.61E-02	U	-4.10E-03 ± 5.73E-02	U	-1.40E-03 ± 6.28E-02	U	1.48E-01 ± 7.07E-02	UJ
Bismuth - 211										
Cerium - 144	3.82E-02 ± 1.47E-01	U	-1.32E-01 ± 1.20E-01	U	-1.45E-01 ± 1.09E-01	U	-1.37E-01 ± 1.23E-01	U	3.43E-02 ± 1.56E-01	U
Cesium - 134	-3.80E-03 ± 2.86E-02	U	-1.60E-02 ± 2.03E-02	U	-1.41E-02 ± 2.24E-02	U	-1.07E-02 ± 2.65E-02	U	4.19E-02 ± 2.99E-02	U
Cesium - 137	2.88E+00 ± 1.51E-01		7.09E-01 ± 5.06E-02		1.18E-01 ± 4.66E-02	J	3.30E-02 ± 2.92E-02	U	1.99E-01 ± 6.43E-02	
Cobalt - 58	2.89E-02 ± 5.30E-02	U	1.93E-02 ± 3.48E-02	U	7.57E-02 ± 4.84E-02	U	-7.24E-02 ± 6.21E-02	U	-1.06E-02 ± 5.50E-02	U
Cobalt - 60	2.04E-02 ± 3.50E-02	U	-3.57E-02 ± 2.11E-02	U	2.31E-02 ± 2.75E-02	U	1.19E-02 ± 3.72E-02	U	4.24E-02 ± 3.53E-02	U
Europium - 152	8.94E-02 ± 7.55E-02	U	2.81E-02 ± 4.30E-02	U	2.40E-03 ± 5.37E-02	U	-4.27E-02 ± 5.92E-02	U	8.54E-02 ± 6.94E-02	U
Europium - 154	5.90E-03 ± 8.86E-02	U	-9.61E-02 ± 4.91E-02	U	5.49E-02 ± 7.56E-02	U	-3.02E-01 ± 1.27E-01	U	1.75E-01 ± 7.82E-02	UJ
Europium - 155	4.59E-02 ± 8.98E-02	U	-1.97E-01 ± 4.92E-02	U	1.88E-02 ± 7.19E-02	U	6.03E-02 ± 6.07E-02	U	-1.32E-01 ± 8.41E-02	U
Lead - 211										
Manganese - 54	5.48E-02 ± 3.79E-02	U	2.74E-02 ± 2.15E-02	U	-2.27E-02 ± 2.69E-02	U	6.17E-02 ± 3.35E-02	U	1.15E-02 ± 3.36E-02	U
Niobium - 95	1.33E-01 ± 6.31E-02	UJ	-9.49E-02 ± 5.06E-02	U	-3.50E-02 ± 5.25E-02	U	-2.27E-02 ± 6.77E-02	U	-1.10E-02 ± 6.48E-02	U
Radium - 226	2.92E+00 ± 9.36E-01	UJ	3.27E+00 ± 6.52E-01	UJ	2.44E+00 ± 6.83E-01	UJ	2.68E+00 ± 6.90E-01	UJ	1.61E+00 ± 8.70E-01	UJ
Ruthenium - 103	2.40E-03 ± 9.93E-02	U	-1.19E-01 ± 6.62E-02	U	1.10E-03 ± 8.08E-02	U	-3.94E-02 ± 7.32E-02	U	9.07E-02 ± 1.09E-01	U
Ruthenium - 106	2.50E-01 ± 2.83E-01	U	3.53E-02 ± 1.87E-01	U	-1.79E-01 ± 2.29E-01	U	-6.70E-01 ± 2.59E-01	U	-4.48E-02 ± 3.00E-01	U
Silver - 108m	-2.10E-02 ± 2.19E-02	U	0.00E+02 ± 1.52E-02	U	2.50E-03 ± 1.73E-02	U	-2.64E-02 ± 1.65E-02	U	-6.70E-03 ± 2.02E-02	U
Silver - 110m	-1.27E-01 ± 3.74E-02	U	-5.53E-02 ± 2.31E-02	U	4.20E-03 ± 2.61E-02	U	1.85E-02 ± 2.45E-02	U	3.45E-02 ± 3.67E-02	U
Thorium - 227										
Uranium - 235	1.21E-01 ± 1.35E-01	U	1.14E-01 ± 1.08E-01	U	1.38E-01 ± 9.23E-02	U	-4.44E-02 ± 1.10E-01		2.91E-02 ± 1.54E-01	
Zinc - 65	-9.45E-02 ± 8.33E-02	U	-1.05E-01 ± 5.85E-02	U	1.66E-02 ± 6.08E-02	U	-1.42E-01 ± 1.05E-01	U	1.45E-01 ± 7.81E-02	U
Zirconium - 95	2.17E-01 ± 9.52E-02	UJ	1.27E-01 ± 7.24E-02	U	-1.56E-02 ± 8.13E-02	U	-8.41E-02 ± 1.27E-01	U	-3.91E-02 ± 9.59E-02	U

a. The DQF column contains any data qualifier flags.

ECOLOGICAL STUDY AREA - ABIOTIC SAMPLES - ANALYSIS RESULTS FOR RADIONUCLIDE DATA (Continued)

AREA	CPP PLUME AREA		IND. WASTE POND		IND. WASTE POND		IND. WASTE POND		IND. WASTE POND	
LOCATION	ESA - #5		AQUATIC ESA #1		AQUATIC ESA #1		AQUATIC ESA #1		AQUATIC ESA #1	
TYPE OF LOCATION	SURFACE SOIL		SEDIMENT		SEDIMENT		SURFACE WATER		SURFACE WATER	
SAMPLE NUMBER	ESA00502FR		ESA00601FR		ESA00602FR		ESA00701FR		ESA00702FR	
MEDIA	SOIL	D	SEDIMENT	D	SEDIMENT	D	WATER	D	WATER	D
UNITS	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/L	Q	pCi/L	Q
SDG NUMBER	ESA00101FR	F	ESA00101FR	F	ESA00101FR	F	ESA00101FR	F	ESA00101FR	F
FIELD MEASUREMENT Depth (ft)	0-2		N/A		N/A		N/A		N/A	
Gross Alpha	8.97E+00 ± 1.34E+00		5.98E+00 ± 1.17E+00		8.64E+00 ± 1.60E+00		2.99E+00 ± 7.75E-01		1.85E+00 ± 6.27E-01	
Gross Beta	6.57E+00 ± 1.08E+00		1.23E+01 ± 1.42E+00		5.01E+01 ± 3.24E+00		8.44E+00 ± 1.26E+00		4.52E+00 ± 1.01E+00	
Alpha Emitters										
Americium - 241	7.19E-02 ± 1.37E-02		1.71E-02 ± 9.78E-03	U	6.79E-02 ± 1.32E-02		2.92E-03 ± 1.28E-02	U	2.86E-02 ± 1.60E-02	U
Plutonium - 238	9.30E-03 ± 9.00E-03	U	1.74E-02 ± 9.92E-03	U	9.52E-03 ± 7.80E-03	U	1.65E-02 ± 2.07E-02	U	-7.23E-03 ± 1.93E-02	U
Plutonium - 239	6.57E-03 ± 5.79E-03	U	1.85E-02 ± 7.42E-03	J	6.19E-02 ± 1.43E-02		3.29E-02 ± 1.44E-02	UJ	-1.73E-02 ± 1.17E-02	U
Uranium - 234	1.07E+00 ± 8.89E-02		1.26E+00 ± 9.97E-02		4.29E+00 ± 2.81E-01		3.03E+00 ± 2.31E-01		1.39E+00 ± 1.30E-01	
Uranium - 235	4.96E-02 ± 1.43E-02		6.80E-02 ± 1.62E-02		1.99E-01 ± 3.04E-02		1.33E-01 ± 3.22E-02	UJ	3.55E-02 ± 1.72E-02	UJ
Uranium - 238	9.36E-01 ± 8.09E-02		9.87E-01 ± 8.31E-02		2.30E+00 ± 1.63E-01		1.11E+00 ± 1.10E-01		5.22E-01 ± 7.00E-02	
Beta Emitters										
Strontium - 90	8.08E-02 ± 5.22E-02	U	6.72E-02 ± 5.49E-02	U	2.46E-01 ± 5.84E-02		2.30E-01 ± 1.51E-01	U	-8.65E-02 ± 1.31E-01	U
Gamma Emitters										
Americium - 241	-1.69E-01 ± 1.08E-01	U	-8.34E-02 ± 1.82E-01	U	-1.02E-01 ± 2.45E-01		-3.65E-00 ± 8.33E+00	U	-2.10E+01 ± 1.89E+01	U
Antimony - 125	1.19E-01 ± 5.48E-02	UJ	-2.86E-01 ± 1.17E-01	U	2.06E-01 ± 2.03E-01	U	5.79E+00 ± 4.75E+00	U	-7.96E+00 ± 8.92E+00	U
Bismuth - 211										
Cerium - 144	-5.76E-02 ± 1.16E-01	U	1.66E-01 ± 1.71E-01	U	2.65E-01 ± 2.16E-01	U	1.13E+00 ± 1.42E+01	U	1.97E+01 ± 1.87E+01	U
Cesium - 134	-1.00E-03 ± 2.20E-02	U	4.00E-03 ± 3.46E-02	U	-8.99E-02 ± 5.14E-02	U	-3.38E+00 ± 2.08E+00	U	-1.51E+00 ± 3.86E+00	U
Cesium - 137	1.93E-01 ± 4.90E-02		1.51E+01 ± 5.53E-01		4.59E+01 ± 1.56E+00		3.21E-02 ± 1.96E+00	U	-1.83E+00 ± 4.65E+00	U
Cobalt - 58	-9.30E-03 ± 5.19E-02	U	5.18E-02 ± 3.31E-02	U	4.76E-02 ± 3.16E-02	U	-3.36E+00 ± 2.33E+00	U	-2.16E+00 ± 4.54E+00	U
Cobalt - 60	-5.80E-03 ± 3.13E-02	U	1.09E-01 ± 4.47E-02	UJ	4.60E-02 ± 5.04E-02	U	3.70E-01 ± 2.29E+00	U	5.72E+00 ± 5.07E+00	U
Europium - 152	8.72E-02 ± 5.36E-02	U	1.03E-01 ± 1.16E-01	U	1.65E-01 ± 1.66E-01	U	-2.90E+00 ± 5.02E+00	U	-1.13E+01 ± 1.04E+01	U
Europium - 154	-1.90E-03 ± 8.71E-02	U	-3.02E-02 ± 7.95E-02	U	-2.88E-01 ± 9.70E-02	U	-4.03E+00 ± 6.08E+00	U	-7.54E+00 ± 1.42E+01	U
Europium - 155	-5.65E-02 ± 6.42E-02	U	-1.38E-01 ± 9.85E-02	U	3.83E-01 ± 1.28E-01	UJ	-1.77E+01 ± 5.82E+00	U	-1.21E+01 ± 8.58E+00	U
Lead - 211										
Manganese - 54	-4.56E-02 ± 2.73E-02	U	-1.07E-02 ± 2.73E-02	U	3.14E-02 ± 4.16E-02	U	-1.11E+00 ± 2.19E+00	U	2.12E+00 ± 3.76E+00	U
Niobium - 95	-8.84E-02 ± 5.72E-02	U	-2.15E-02 ± 3.86E-02	U	-3.72E-02 ± 4.28E-02	U	3.56E+00 ± 2.73E+00	U	-5.53E+00 ± 4.57E+00	U
Radium - 226	3.57E+00 ± 7.31E-01	UJ	3.16E+00 ± 1.16E+00	UJ	2.85E+00 ± 1.16E+00	UJ	-3.93E+01 ± 5.10E+01	U	-1.14E+02 ± 7.30E+01	U
Ruthenium - 103	2.65E-02 ± 7.20E-02	U	2.22E-02 ± 6.94E-02	U	5.71E-02 ± 1.07E-01	U	0.00E+00 ± 2.84E+00	U	-1.88E+00 ± 4.37E+00	U
Ruthenium - 106	-1.97E-02 ± 2.21E-01	U	2.54E-01 ± 3.44E-01	U	8.69E-01 ± 5.16E-01	U	-1.75E+01 ± 2.02E+01	U	3.49E+00 ± 3.33E+01	U
Silver - 108m	-1.45E-02 ± 1.50E-02	U	-3.36E-02 ± 4.02E-02	U	1.41E-01 ± 6.73E-02	UJ	-4.10E-01 ± 1.90E+00	U	-2.69E+00 ± 2.79E+00	U
Silver - 110m	2.59E-02 ± 2.28E-02	U	-1.37E-01 ± 4.95E-02	U	-3.98E-01 ± 7.57E-02	U	-3.85E+00 ± 1.83E+00	U	8.70E-01 ± 2.88E+00	U
Thorium - 227										
Uranium - 235	-4.34E-02 ± 9.34E-02	U	-3.64E-01 ± 1.95E-01	U	2.85E-02 ± 2.18E-01	U	-5.63E+00 ± 1.41E+01	U	-4.38E+00 ± 1.78E+01	U
Zinc - 65	-6.24E-02 ± 8.01E-02	U	-3.62E-02 ± 6.47E-02	U	1.07E-01 ± 7.88E-02	U	9.90E-01 ± 5.47E+00	U	1.06E+01 ± 9.32E+00	U
Zirconium - 95	1.81E-01 ± 8.98E-02	UJ	-7.93E-02 ± 6.71E-02	U	6.09E-02 ± 6.84E-02	U	6.25E+00 ± 4.36E+00	U	1.58E+01 ± 7.93E+00	U

a. The DQF column contains any data qualifier flags.

ECOLOGICAL STUDY AREA - ABIOTIC SAMPLES - ANALYSIS RESULTS FOR RADIONUCLIDE DATA (Continued)

AREA	REF. STUDY AREA		REF. STUDY AREA		REF. STUDY AREA		REF. STUDY AREA		REF. STUDY AREA	
LOCATION	RSA - #1		RSA - #2		RSA - #3		RSA - #4		RSA - #5	
TYPE OF LOCATION	SURFACE SOIL		SURFACE SOIL		SURFACE SOIL		SURFACE SOIL		SURFACE SOIL	
SAMPLE NUMBER	ESA00801FR		ESA00901FR		ESA01001FR		ESA01101FR		ESA01201FR	
MEDIA	SOIL	D	SOIL	D	SOIL	D	SOIL	D	SOIL	D
UNITS	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q
SDG NUMBER	ESA00101FR	F	ESA00101FR	F	ESA00101FR	F	ESA00101FR	F	ESA00101FR	F
FIELD MEASUREMENT										
Depth (ft)	0-2		0-2		0-2		0-2		0-2	
Gross Alpha	4.39E+00 ± 1.16E+00		5.51E+00 ± 1.38E+00		5.36E+00 ± 1.10E+00		5.85E+00 ± 1.17E+00		4.86E+00 ± 1.04E+00	
Gross Beta	7.07E+00 ± 1.35E+00		5.75E+00 ± 1.23E+00		5.16E+00 ± 1.00E+00		5.85E+00 ± 1.03E+00		7.04E+00 ± 1.12E+00	
Alpha Emitters										
Americium - 241	-1.32E-03 ± 9.48E-03	U	2.62E-01 ± 2.97E-02		1.55E-02 ± 7.21E-03		1.04E-02 ± 7.91E-03	U	5.98E-02 ± 1.31E-02	
Plutonium - 238	-1.56E-03 ± 5.36E-03	U	5.31E-04 ± 4.29E-03	U	9.07E-03 ± 5.80E-03	U	7.91E-03 ± 5.88E-03	U	1.73E-03 ± 7.35E-03	U
Plutonium - 239	5.19E-03 ± 4.21E-03	U	4.25E-03 ± 4.30E-03	U	1.30E-02 ± 6.36E-03	UJ	6.22E-03 ± 5.06E-03	U	-1.15E-03 ± 4.66E-03	U
Uranium - 234	6.86E-01 ± 6.64E-02		7.74E-01 ± 7.20E-02		8.23E-01 ± 7.50E-02		7.30E-01 ± 6.68E-02		6.97E-01 ± 6.55E-02	
Uranium - 235	4.96E-02 ± 1.46E-02		2.96E-02 ± 1.11E-02		6.62E-02 ± 1.69E-02		3.41E-02 ± 1.13E-02		4.08E-02 ± 1.37E-02	
Uranium - 238	7.51E-01 ± 7.05E-02		6.92E-01 ± 6.67E-02		8.80E-01 ± 7.87E-02		7.12E-01 ± 6.58E-02		7.26E-01 ± 6.74E-02	
Beta Emitters										
Strontium - 90	9.63E-02 ± 5.64E-02	U	9.99E-03 ± 4.97E-02	U	1.91E-02 ± 4.93E-02	U	-7.58E-02 4.71E-02	U	1.05E-01 5.22E-02	U
Gamma Emitters										
Americium - 241	2.16E-01 ± 1.71E-01	U	-3.76E-02 ± 5.08E-02	U	-1.29E-01 ± 1.88E-01	U	-4.70E-03 ± 1.39E-01	U	2.54E-02 ± 1.69E-01	U
Antimony - 125	9.77E-02 ± 7.34E-02	U	5.60E-03 ± 4.43E-02	U	9.92E-02 ± 6.79E-02	U	1.34E-02 ± 8.02E-02	U	-3.20E-02 ± 6.70E-02	U
Bismuth - 211										
Cerium - 144	-7.37E-02 ± 1.50E-01	U	-3.57E-01 ± 1.21E-01	U	-3.85E-02 ± 1.14E-01	U	8.07E-02 ± 1.40E-01	U	-5.60E-03 ± 1.60E-01	U
Cesium - 134	0.00E+02 ± 3.09E-02	U	-3.55E-02 ± 2.18E-02	U	1.32E-02 ± 2.61E-02	U	3.62E-02 ± 2.98E-02	U	7.53E-02 ± 3.09E-02	UJ
Cesium - 137	5.33E-02 ± 3.47E-02	U	5.15E-02 ± 2.05E-02	UJ	6.73E-02 ± 3.13E-02	UJ	2.01E-02 ± 3.17E-02	U	9.55E-02 ± 3.81E-02	J
Cobalt - 58	-3.12E-02 ± 5.40E-02	U	-6.30E-02 ± 3.91E-02	U	1.35E-02 ± 4.86E-02	U	-1.37E-01 ± 7.18E-02	U	-1.58E-02 ± 5.44E-02	U
Cobalt - 60	-7.96E-02 ± 3.74E-02	U	4.46E-02 ± 2.04E-02	UJ	-6.81E-02 ± 3.05E-02	U	2.12E-02 ± 4.62E-02	U	-2.25E-02 ± 3.92E-02	U
Europium - 152	8.44E-02 ± 7.51E-02	U	-2.27E-02 ± 4.46E-02	U	1.04E-01 ± 5.90E-02	U	8.40E-03 ± 6.78E-02	U	7.57E-02 ± 7.58E-02	U
Europium - 154	-1.97E-02 ± 8.29E-02	U	1.24E-01 ± 5.35E-02	UJ	-6.10E-03 ± 8.51E-02	U	-7.13E-02 ± 1.23E-01	U	1.97E-01 ± 1.15E-01	U
Europium - 155	9.33E-02 ± 8.51E-02	U	-6.33E-02 ± 5.11E-02	U	-4.21E-02 ± 7.73E-02	U	-3.86E-02 ± 7.08E-02	U	-1.92E-01 ± 8.52E-02	U
Lead - 211										
Manganese - 54	7.34E-02 ± 3.49E-02	UJ	8.90E-03 ± 2.16E-02	U	1.66E-02 ± 2.29E-02	U	1.80E-02 ± 3.62E-02	U	5.88E-02 ± 3.53E-02	U
Niobium - 95	-2.74E-02 ± 5.47E-02	U	-9.16E-02 ± 4.97E-02	U	-1.05E-01 ± 6.13E-02	U	-1.52E-01 ± 7.37E-02	U	-1.53E-01 ± 7.56E-02	U
Radium - 226	2.09E+00 ± 8.64E-01	UJ	1.81E+00 ± 6.27E-01	UJ	3.70E+00 ± 8.11E-01	UJ	1.94E+00 ± 9.19E-01	UJ	2.41E+00 ± 1.19E+00	UJ
Ruthenium - 103	1.16E-01 ± 8.66E-02	U	9.11E-02 ± 6.00E-02	U	-5.88E-02 ± 8.40E-02	U	8.27E-02 ± 1.06E-01	U	4.78E-02 ± 1.02E-01	U
Ruthenium - 106	2.15E-01 ± 3.06E-01	U	2.46E-01 ± 2.01E-01	U	-1.24E-01 ± 2.24E-01	U	-1.05E-01 ± 3.16E-01	U	5.10E-02 ± 3.19E-01	U
Silver - 108m	-8.70E-03 ± 2.23E-02	U	6.00E-03 ± 1.51E-02	U	-1.86E-02 ± 1.96E-02	U	-3.30E-02 ± 2.14E-02	U	-1.67E-02 ± 2.12E-02	U
Silver - 110m	3.22E-02 ± 3.14E-02	U	1.19E-02 ± 2.20E-02	U	2.04E-02 ± 2.70E-02	U	-3.30E-03 ± 3.61E-02	U	-1.19E-02 ± 3.36E-02	U
Thorium - 227										
Uranium - 235	-5.41E-02 ± 1.14E-01	U	-4.42E-02 ± 1.02E-01	U	5.84E-02 ± 1.01E-01		6.24E-02 ± 1.35E-01	U	1.10E-01 ± 1.59E-01	U
Zinc - 65	4.06E-02 ± 7.29E-02	U	2.59E-02 ± 5.75E-02	U	-3.83E-02 ± 6.84E-02	U	-1.90E-01 ± 1.01E-01	U	5.15E-02 ± 7.32E-02	U
Zirconium - 95	-3.83E-02 ± 1.01E-01	U	-5.79E-02 ± 8.45E-02	U	1.41E-01 ± 9.59E-02	U	-1.32E-01 ± 1.03E-01	U	1.92E-01 ± 1.02E-01	U

a. The DQF column contains any data qualifier flags

ECOLOGICAL STUDY AREA - ABIOTIC SAMPLES - ANALYSIS RESULTS FOR RADIONUCLIDE DATA (Continued)

AREA	REF. STUDY AREA	
LOCATION	RSA - #5	
TYPE OF LOCATION	SURFACE SOIL	
SAMPLE NUMBER	ESA01202FR	
MEDIA	SOIL	D
UNITS	pCi/g	Q
SDG NUMBER	ESA00101FR	F
FIELD MEASUREMENT		
Depth (ft)	0-2	
Gross Alpha	6.49E+00 ± 1.14E+00	
Gross Beta	3.81E+00 ± 9.23E-01	
Alpha Emitters		
Americium - 241	2.20E-02 ± 8.60E-03	UJ
Plutonium - 238	2.55E-02 ± 9.31E-03	UJ
Plutonium - 239	3.48E-03 ± 4.69E-03	U
Uranium - 234	6.94E-01 ± 6.49E-02	
Uranium - 235	4.13E-02 ± 1.27E-02	
Uranium - 238	7.83E-01 ± 7.05E-02	
Beta Emitters		
Strontium - 90	3.41E-02 ± 4.96E-02	U
Gamma Emitters		
Americium - 241	-1.94E-01 ± 1.05E-01	U
Antimony - 125	8.72E-02 ± 6.01E-02	U
Bismuth - 211		
Cerium - 144	8.74E-02 ± 1.04E-01	U
Cesium - 134	5.40E-03 ± 2.31E-02	U
Cesium - 137	9.13E-02 ± 5.25E-02	U
Cobalt - 58	-4.09E-02 ± 5.21E-02	U
Cobalt - 60	-5.50E-03 ± 3.45E-02	U
Europium - 152	-5.92E-02 ± 5.22E-02	U
Europium - 154	1.86E-01 ± 8.20E-02	UJ
Europium - 155	-6.57E-02 ± 5.97E-02	U
Lead - 211		
Manganese - 54	3.46E-02 ± 2.95E-02	U
Niobium - 95	4.10E-03 ± 5.72E-02	U
Radium - 226	1.86E+00 ± 5.02E-01	UJ
Ruthenium - 103	-4.89E-02 ± 7.47E-02	U
Ruthenium - 106	-2.92E-01 ± 2.27E-01	U
Silver - 108m	3.90E-03 ± 1.75E-02	U
Silver - 110m	-3.50E-03 ± 2.86E-02	U
Thorium - 227		
Uranium - 235	1.94E-01 ± 1.02E-01	
Zinc - 65	1.24E-01 ± 6.94E-02	U
Zirconium - 95	1.04E-02 ± 8.76E-02	U

a. The DQF column contains any data qualifier flags.

ECOLOGICAL STUDY AREA - ABIOTIC SAMPLES - ANALYSIS RESULTS FOR RADIONUCLIDE RINSATE DATA

AREA	ESA		REF. STUDY AREA	
LOCATION	QC		QC	
TYPE OF LOCATION	RINSATE		RINSATE	
SAMPLE NUMBER	ESA01301FR		ESA01403FR	
MEDIA	WATER	D	WATER	D
UNITS	pCi/L	Q	pCi/L	Q
SDG NUMBER	ESA01301FR	F	ESA01301FR	F
Gross Alpha	4.79E-01 ± 4.47E-01	U	7.90E-01 ± 4.91E-01	U
Gross Beta	1.05E-01 ± 9.76E-01	U	-4.09E-01 ± 9.39E-01	U
Alpha Emitters				
Americium - 241	3.19E-02 ± 1.83E-02	U	3.10E-02 ± 1.37E-02	J
Plutonium - 238	1.51E-02 ± 1.23E-02	U	4.76E-02 ± 1.89E-02	J
Plutonium - 239	2.46E-02 ± 1.38E-02	U	3.70E-02 ± 1.62E-02	U
Uranium - 234	4.62E-02 ± 1.72E-02	UJ	5.18E-02 ± 1.90E-02	UJ
Uranium - 235	9.70E-03 ± 8.96E-03	U	1.18E-02 ± 1.00E-02	U
Uranium - 238	1.83E-02 ± 1.32E-02	U	4.00E-02 ± 1.60E-02	UJ
Beta Emitters				
Strontium - 90	1.25E-02 ± 7.43E-02	U	-5.55E-02 ± 6.29E-02	U
Gamma Emitters				
Americium - 241	-1.90E+01 ± 2.17E+01	U	1.58E+01 ± 8.90E+00	U
Antimony - 125	-6.06E+00 ± 1.32E+01	U	-9.92E+00 ± 5.18E+00	U
Bismuth - 211				
Cerium - 144	2.11E+01 ± 2.30E+01	U	8.87E+00 ± 1.36E+01	U
Cesium - 134	2.93E+00 ± 4.88E+00	U	-1.49E+00 ± 2.53E+00	U
Cesium - 137	-4.86E+00 ± 5.40E+00	U	1.43E+00 ± 1.96E+00	U
Cobalt - 58	1.03E+00 ± 7.06E+00	U	-4.67E-01 ± 2.49E+00	U
Cobalt - 60	-7.59E+00 ± 5.38E+00	U	-1.11E+00 ± 2.42E+00	U
Europium - 152	-4.80E+00 ± 1.27E+01	U	-1.02E+01 ± 5.39E+00	U
Europium - 154	-2.72E+00 ± 1.53E+01	U	4.36E+00 ± 6.17E+00	U
Europium - 155	5.37E-01 ± 1.12E+01	U	-1.30E+01 ± 5.86E+00	U
Lead - 211				
Manganese - 54	-4.94E+00 ± 6.31E+00	U	1.39E+00 ± 2.35E+00	U
Niobium - 95	-1.51E+00 ± 5.67E+00	U	-3.08E+00 ± 2.90E+00	U
Radium - 226	2.28E+02 ± 9.33E+01	UJ	-1.41E+01 ± 5.51E+01	U
Ruthenium - 103	4.24E+00 ± 8.59E+00	U	-2.48E+00 ± 2.94E+00	U
Ruthenium - 106	1.28E+01 ± 3.95E+01	U	-9.98E+00 ± 2.09E+01	U
Silver - 108m	3.14E+00 ± 4.59E+00	U	2.43E+00 ± 1.90E+00	U
Silver - 110m	2.27E+00 ± 5.33E+00	U	-8.27E-01 ± 1.89E+00	U
Thorium - 227				
Uranium - 235	-1.29E+01 ± 2.32E+01	U	-1.80E+00 ± 1.31E+01	U
Zinc - 65	-1.09E+01 ± 1.41E+01	U	-2.23E+00 ± 5.41E+00	U
Zirconium - 95	-1.35E+00 ± 1.27E+01	U	1.07E-01 ± 4.20E+00	U

a. The DQF column contains any data qualifier flags.

5-27-98

LOCKHEED MARTIN

Lockheed Martin Idaho Technologies Company

INTERDEPARTMENTAL COMMUNICATION

Date:	May 29, 1998		
To:	Susan M. Barna	MS 3959	6-9382
From:	Donna R. Kirchner	MS 3960	6-9873
Subject:	TRANSMITTAL OF RESULT TABLES FOR THE ECOLOGICAL STUDY AREA - BIOTIC SAMPLES PROJECT - DRK-42-98		

Enclosed please find the following Result Tables for the Ecological Study Area – Biotic Samples Project.

Inorganic

Result Tables

Ecological Study Area – Biotic Samples – Inorganic Data (Method Validation Level A, table dated 5-28-98)

Radionuclide

Result Tables

Ecological Study Area – Biotic Samples – Analysis Results for Radionuclide Data (Method Validation Level A, table dated 5-29-98)

After reviewing the Ecological Study Area – Biotic Samples Plan Table Number ERA-BIOTIC, Revision 2.0, dated July 9, 1997, the following was noted:

Sample Activities and Samples Planned But Not Collected

ESA211 – ESA220
ESA22101HW
ESA22201HW
ESA22301HW
ESA22401HW
ESA22501HW
ESA22502FR
ESA22502HW
ESA22502LA
ESA22601HW
ESA22701HW

ESA22801HW
ESA22901HW
ESA23001HW
ESA2302HW
ESA241 – ESA245
ESA25101HW
ESA25201HW
ESA25301HW
ESA25401HW
ESA25501HW
ESA25502HW
ESA25601HW
ESA25701HW
ESA25801HW
ESA25901HW
ESA26001HW
ESA26002HW

Samples Collected But Not Planned

None

Notes: (1) Sample ESA24001LA was combined with ESA24002LA and samples ESA24001FR and ESA24002FR were combined.

(2) The data results for the animal biota samples have not been received.

Please review the enclosed tables carefully. If you have any questions, or would like any changes, please do not hesitate to contact me at 526-9873 or Lotus Notes DRK.

DRK

Enclosure

cc: (w/o Encl)
Tom J. Haney, (w/Encl), MS 3953
Mary W. Hudson, (w/Encl), MS 3960
Michelle Johnson, MS 3960
Ecological Study Area – Biotic Samples Project File
Project File ESA2-01
Project File ESA2-02
Project File ESA2-03
Project File ESA2-04
Project File ESA2-05
Project File ESA2-06
Project File ESA2-07
Project File ESA2-08
Donna R. Kirchner File
File Code 6404

Status of Data Packages
Ecological Study Area - Biotic Samples
July 1997
T. J. Haney

SDG Number	Packet No.	Analysis Type	Action Date	Action Taken
** Packet No.: ESA2-0				
ESA25101LA	ESA2-01	METALS - (TAL)	02/02/98	Received from SMO - LBR-76-98
ESA25101LA	ESA2-01	METALS - (TAL)	02/02/98	Cursory Technical Review
ESA25101LA	ESA2-01	METALS - (TAL)	02/02/98	Enter Form 1's Only
ESA25101LA	ESA2-01	METALS - (TAL)	02/02/98	Validation "A" Req - LBR-76-98
ESA25101LA	ESA2-01	METALS - (TAL)	02/02/98	Validation Due: 2-23-98
ESA25101LA	ESA2-01	METALS - (TAL)	02/04/98	Initial Data Entry
ESA25101LA	ESA2-01	METALS - (TAL)	02/10/98	ERIS Upload(C) Req - DJ-40-98
ESA25101LA	ESA2-01	METALS - (TAL)	02/10/98	ASCII File to M. Engelhardt
ESA25101LA	ESA2-01	METALS - (TAL)	03/02/98	Validation "A" Rec - BAM-21-98
ESA25101LA	ESA2-01	METALS - (TAL)	03/17/98	ERIS Upload(A) Req - DJ-159-98
ESA25101LA	ESA2-01	METALS - (TAL)	03/18/98	Updated ASCII File to M. Englehardt
ESA25101LA	ESA2-01	METALS - (TAL)	05/28/98	Result Tables Produced
ESA25101LA	ESA2-01	METALS - (TAL)	05/29/98	Tables to SMB - DRK-42-98
** Packet No.: ESA2-0				
ESA25101FR	ESA2-02	RADS	02/02/98	Received from SMO - LBR-76-98
ESA25101FR	ESA2-02	RADS	02/02/98	Diskette Deliverable (15702*.ASC)
ESA25101FR	ESA2-02	RADS	02/02/98	Cursory Technical Review
ESA25101FR	ESA2-02	RADS	02/02/98	Validation "A" Req - LBR-76-98
ESA25101FR	ESA2-02	RADS	02/02/98	Validation Due: 2-23-98
ESA25101FR	ESA2-02	RADS	02/26/98	Download Diskette Deliverable
ESA25101FR	ESA2-02	RADS	02/26/98	Diskette Missing Data
ESA25101FR	ESA2-02	RADS	03/10/98	Validation "A" Rec - BAM-27-98
ESA25101FR	ESA2-02	RADS	03/18/97	ERIS Upload(A) Req - DJ-160-98
ESA25101FR	ESA2-02	RADS	03/18/97	ASCII File to M. Engelhardt
ESA25101FR	ESA2-02	RADS	05/29/97	Result Table Produced
ESA25101FR	ESA2-02	RADS	05/29/97	Table to SMB - DRK-42-98
** Packet No.: ESA2-0				
ESA20101LA	ESA2-03	METALS - (TAL)	02/02/98	Received from SMO - LBR-76-98
ESA20101LA	ESA2-03	METALS - (TAL)	02/02/98	Cursory Technical Review
ESA20101LA	ESA2-03	METALS - (TAL)	02/02/98	Enter Form 1's Only
ESA20101LA	ESA2-03	METALS - (TAL)	02/02/98	Validation "A" Req - LBR-76-98
ESA20101LA	ESA2-03	METALS - (TAL)	02/02/98	Validation Due: 2-23-98
ESA20101LA	ESA2-03	METALS - (TAL)	02/03/98	Initial Data Entry
ESA20101LA	ESA2-03	METALS - (TAL)	02/10/98	ERIS Upload(C) Req - DJ-41-98
ESA20101LA	ESA2-03	METALS - (TAL)	02/10/98	ASCII File to M. Engelhardt
ESA20101LA	ESA2-03	METALS - (TAL)	03/23/98	Validation "A" Rec - BAM-33-98
ESA20101LA	ESA2-03	METALS - (TAL)	04/14/98	ERIS Upload(A) Req - DJ-214-98
ESA20101LA	ESA2-03	METALS - (TAL)	04/14/98	DBJ Notes to MCI2 - Form 1 Problem
ESA20101LA	ESA2-03	METALS - (TAL)	04/15/98	ASCII File to M. Engelhardt
ESA20101LA	ESA2-03	METALS - (TAL)	05/28/98	Result Table Produced
ESA20101LA	ESA2-03	METALS - (TAL)	05/29/98	Table to SMB - DRK-42-98
** Packet No.: ESA2-0				
ESA20101FR	ESA2-04	RADS	02/02/98	Received from SMO - LBR-76-98
ESA20101FR	ESA2-04	RADS	02/02/98	Diskette Deliverable (15700*.ASC)
ESA20101FR	ESA2-04	RADS	02/02/98	Cursory Technical Review
ESA20101FR	ESA2-04	RADS	02/02/98	Validation "A" Req - LBR-76-98
ESA20101FR	ESA2-04	RADS	02/02/98	Validation Due: 2-23-98
ESA20101FR	ESA2-04	RADS	02/26/98	Download Diskette Deliverable
ESA20101FR	ESA2-04	RADS	03/24/98	Validation "A" Rec - BAM-34-98
ESA20101FR	ESA2-04	RADS	04/15/98	ERIS Upload(A) Req - DJ-216-98
ESA20101FR	ESA2-04	RADS	04/15/98	ASCII File to M. Engelhardt
ESA20101FR	ESA2-04	RADS	05/29/98	Result Table Produced
ESA20101FR	ESA2-04	RADS	05/29/98	Table to SMB - DRK-42-98
** Packet No.: ESA2-0				
ESA25601LA	ESA2-05	METALS - (TAL)	02/02/98	Received from SMO - LBR-76-98
ESA25601LA	ESA2-05	METALS - (TAL)	02/02/98	Cursory Technical Review
ESA25601LA	ESA2-05	METALS - (TAL)	02/02/98	Enter Form 1's Only
ESA25601LA	ESA2-05	METALS - (TAL)	02/02/98	Validation "A" Req - LBR-76-98
ESA25601LA	ESA2-05	METALS - (TAL)	02/02/98	Validation Due: 2-23-98
ESA25601LA	ESA2-05	METALS - (TAL)	02/04/98	Initial Data Entry

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SDG Number	Packet No.	Analysis Type	Action Date	Action Taken
ESA25601LA	ESA2-05	METALS - (TAL)	02/10/98	ERIS Upload(C) Req - DJ-42-98
ESA25601LA	ESA2-05	METALS - (TAL)	02/10/98	ASCII File to M. Engelhardt
ESA25601LA	ESA2-05	METALS - (TAL)	03/18/98	Validation "A" Rec - BAM-32-98
ESA25601LA	ESA2-05	METALS - (TAL)	03/23/98	ERIS Upload(A) Req - DJ-169-98
ESA25601LA	ESA2-05	METALS - (TAL)	03/23/98	ASCII File to M. Engelhardt
ESA25601LA	ESA2-05	METALS - (TAL)	05/28/98	Result Table Produced
ESA25601LA	ESA2-05	METALS - (TAL)	05/29/98	Table to SMB - DRK-42-98
** Packet No.: ESA2-0				
ESA22601FR	ESA2-06	RADS	02/02/98	Received from SMO - LBR-76-98
ESA22601FR	ESA2-06	RADS	02/02/98	Diskette Deliverable (15701*.ASC)
ESA22601FR	ESA2-06	RADS	02/02/98	Cursory Technical Review
ESA22601FR	ESA2-06	RADS	02/02/98	Validation "A" Req - LBR-76-98
ESA22601FR	ESA2-06	RADS	02/02/98	Validation Due: 2-23-98
ESA22601FR	ESA2-06	RADS	02/26/98	Download Diskette Deliverable
ESA22601FR	ESA2-06	RADS	03/12/98	Validation "A" Rec - BAM-31-98
ESA22601FR	ESA2-06	RADS	03/23/98	DBJ Notes to MC12 - SDG Number ?
ESA22601FR	ESA2-06	RADS	03/23/98	MC12 Notes to DBJ-Will Reissue L&V
ESA22601FR	ESA2-06	RADS	03/24/98	ERIS Upload(A) Req - DJ-170-98
ESA22601FR	ESA2-06	RADS	03/24/98	ASCII File to M. Engelhardt
ESA22601FR	ESA2-06	RADS	05/29/98	Result Table Produced
ESA22601FR	ESA2-06	RADS	05/29/98	Table to SMB - DRK-42-98
** Packet No.: ESA2-0				
ESA20601LA	ESA2-07	METALS - (TAL)	02/02/98	Received from SMO - LBR-76-98
ESA20601LA	ESA2-07	METALS - (TAL)	02/02/98	Cursory Technical Review
ESA20601LA	ESA2-07	METALS - (TAL)	02/02/98	Enter Form 1's Only
ESA20601LA	ESA2-07	METALS - (TAL)	02/02/98	Validation "A" Req - LBR-76-98
ESA20601LA	ESA2-07	METALS - (TAL)	02/02/98	Validation Due: 2-23-98
ESA20601LA	ESA2-07	METALS - (TAL)	02/04/98	Initial Data Entry
ESA20601LA	ESA2-07	METALS - (TAL)	02/10/98	ERIS Upload(C) Req - DJ-43-98
ESA20601LA	ESA2-07	METALS - (TAL)	02/10/98	ASCII File to M. Engelhardt
ESA20601LA	ESA2-07	METALS - (TAL)	03/31/98	Validation "A" Rec - BAM-35-98
ESA20601LA	ESA2-07	METALS - (TAL)	04/14/98	ERIS Upload(A) Req - DJ-213-98
ESA20601LA	ESA2-07	METALS - (TAL)	04/15/98	ASCII File to M. Engelhardt
ESA20601LA	ESA2-07	METALS - (TAL)	05/28/98	Result Table Produced
ESA20601LA	ESA2-07	METALS - (TAL)	05/29/98	Table to SMB - DRK-42-98
** Packet No.: ESA2-0				
ESA20601FR	ESA2-08	RADS	02/02/98	Received from SMO - LBR-76-98
ESA20601FR	ESA2-08	RADS	02/02/98	Diskette Deliverable (15683*.ASC)
ESA20601FR	ESA2-08	RADS	02/02/98	Cursory Technical Review
ESA20601FR	ESA2-08	RADS	02/02/98	Validation "A" Req - LBR-76-98
ESA20601FR	ESA2-08	RADS	02/02/98	Validation Due: 2-23-98
ESA20601FR	ESA2-08	RADS	02/26/98	Download Diskette Deliverable
ESA20601FR	ESA2-08	RADS	04/09/98	Validation "A" Rec - BAM-37-98
ESA20601FR	ESA2-08	RADS	04/15/98	ERIS Upload(A) Req - DJ-217-98
ESA20601FR	ESA2-08	RADS	04/15/98	ASCII File to M. Engelhardt
ESA20601FR	ESA2-08	RADS	05/29/98	Result Table Produced
ESA20601FR	ESA2-08	RADS	05/29/98	Table to SMB - DRK-42-98

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Sample No.	SDG No.	Packet No.	Analysis	Lab Name	Date Received
ESA20101FR	ESA20101FR	ESA2-04	RADS	WASTREN - GJ	02/02/98
ESA20101FR	ESA22601FR	ESA2-06	RADS	WASTREN - GJ	02/02/98
ESA20101LA	ESA20101LA	ESA2-03	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA20201FR	ESA20101FR	ESA2-04	RADS	WASTREN - GJ	02/02/98
ESA20201FR	ESA22601FR	ESA2-06	RADS	WASTREN - GJ	02/02/98
ESA20201LA	ESA20101LA	ESA2-03	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA20301FR	ESA20101FR	ESA2-04	RADS	WASTREN - GJ	02/02/98
ESA20301FR	ESA22601FR	ESA2-06	RADS	WASTREN - GJ	02/02/98
ESA20301LA	ESA20101LA	ESA2-03	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA20401FR	ESA20101FR	ESA2-04	RADS	WASTREN - GJ	02/02/98
ESA20401FR	ESA22601FR	ESA2-06	RADS	WASTREN - GJ	02/02/98
ESA20401LA	ESA20101LA	ESA2-03	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA20501FR	ESA20101FR	ESA2-04	RADS	WASTREN - GJ	02/02/98
ESA20501FR	ESA22601FR	ESA2-06	RADS	WASTREN - GJ	02/02/98
ESA20501LA	ESA20101LA	ESA2-03	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA20502FR	ESA20101FR	ESA2-04	RADS	WASTREN - GJ	02/02/98
ESA20502FR	ESA22601FR	ESA2-06	RADS	WASTREN - GJ	02/02/98
ESA20502LA	ESA20101LA	ESA2-03	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA20601FR	ESA20601FR	ESA2-08	RADS	WASTREN - GJ	02/02/98
ESA20601LA	ESA20601LA	ESA2-07	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA20701FR	ESA20601FR	ESA2-08	RADS	WASTREN - GJ	02/02/98
ESA20701LA	ESA20601LA	ESA2-07	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA20801FR	ESA20601FR	ESA2-08	RADS	WASTREN - GJ	02/02/98
ESA20801LA	ESA20601LA	ESA2-07	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA20901FR	ESA20601FR	ESA2-08	RADS	WASTREN - GJ	02/02/98
ESA20901LA	ESA20601LA	ESA2-07	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA21001FR	ESA20601FR	ESA2-08	RADS	WASTREN - GJ	02/02/98
ESA21001LA	ESA20601LA	ESA2-07	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA21002FR	ESA20601FR	ESA2-08	RADS	WASTREN - GJ	02/02/98
ESA21002LA	ESA20601LA	ESA2-07	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA22101FR	ESA25101FR	ESA2-02	RADS	WASTREN - GJ	02/02/98
ESA22101LA	ESA25101LA	ESA2-01	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA22201LA	ESA25101LA	ESA2-01	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA22301FR	ESA25101FR	ESA2-02	RADS	WASTREN - GJ	02/02/98
ESA22301LA	ESA25101LA	ESA2-01	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA22401FR	ESA25101FR	ESA2-02	RADS	WASTREN - GJ	02/02/98
ESA22401LA	ESA25101LA	ESA2-01	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA22501LA	ESA25101LA	ESA2-01	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA22601FR	ESA22601FR	ESA2-06	RADS	WASTREN - GJ	02/02/98
ESA22601LA	ESA25601LA	ESA2-05	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA22701FR	ESA22601FR	ESA2-06	RADS	WASTREN - GJ	02/02/98
ESA22701LA	ESA25601LA	ESA2-05	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA22801FR	ESA22601FR	ESA2-06	RADS	WASTREN - GJ	02/02/98
ESA22801LA	ESA25601LA	ESA2-05	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA22901FR	ESA22601FR	ESA2-06	RADS	WASTREN - GJ	02/02/98
ESA22901LA	ESA25601LA	ESA2-05	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA23001FR	ESA22601FR	ESA2-06	RADS	WASTREN - GJ	02/02/98
ESA23001LA	ESA25601LA	ESA2-05	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA23101FR	ESA20101FR	ESA2-04	RADS	WASTREN - GJ	02/02/98
ESA23101FR	ESA22601FR	ESA2-06	RADS	WASTREN - GJ	02/02/98
ESA23101LA	ESA20101LA	ESA2-03	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA23201FR	ESA20101FR	ESA2-04	RADS	WASTREN - GJ	02/02/98
ESA23201FR	ESA22601FR	ESA2-06	RADS	WASTREN - GJ	02/02/98
ESA23201LA	ESA20101LA	ESA2-03	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA23301FR	ESA20101FR	ESA2-04	RADS	WASTREN - GJ	02/02/98
ESA23301FR	ESA22601FR	ESA2-06	RADS	WASTREN - GJ	02/02/98

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Sample No.	SDG No.	Packet No.	Analysis	Lab Name	Date Received
ESA23301LA	ESA20101LA	ESA2-03	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA23401FR	ESA20101FR	ESA2-04	RADS	WASTREN - GJ	02/02/98
ESA23401FR	ESA22601FR	ESA2-06	RADS	WASTREN - GJ	02/02/98
ESA23401LA	ESA20101LA	ESA2-03	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA23501FR	ESA20101FR	ESA2-04	RADS	WASTREN - GJ	02/02/98
ESA23501FR	ESA22601FR	ESA2-06	RADS	WASTREN - GJ	02/02/98
ESA23501LA	ESA20101LA	ESA2-03	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA23502FR	ESA20101FR	ESA2-04	RADS	WASTREN - GJ	02/02/98
ESA23502FR	ESA22601FR	ESA2-06	RADS	WASTREN - GJ	02/02/98
ESA23502LA	ESA20101LA	ESA2-03	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA23601FR	ESA20601FR	ESA2-08	RADS	WASTREN - GJ	02/02/98
ESA23601LA	ESA20601LA	ESA2-07	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA23701FR	ESA20601FR	ESA2-08	RADS	WASTREN - GJ	02/02/98
ESA23701LA	ESA20601LA	ESA2-07	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA23801FR	ESA20601FR	ESA2-08	RADS	WASTREN - GJ	02/02/98
ESA23801LA	ESA20601LA	ESA2-07	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA23901FR	ESA20601FR	ESA2-08	RADS	WASTREN - GJ	02/02/98
ESA23901LA	ESA20601LA	ESA2-07	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA24001FR	ESA20601FR	ESA2-08	RADS	WASTREN - GJ	02/02/98
ESA24001LA	ESA20601LA	ESA2-07	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA24002FR	ESA20601FR	ESA2-08	RADS	WASTREN - GJ	02/02/98
ESA25101FR	ESA25101FR	ESA2-02	RADS	WASTREN - GJ	02/02/98
ESA25101LA	ESA25101LA	ESA2-01	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA25201FR	ESA25101FR	ESA2-02	RADS	WASTREN - GJ	02/02/98
ESA25201LA	ESA25101LA	ESA2-01	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA25301FR	ESA25101FR	ESA2-02	RADS	WASTREN - GJ	02/02/98
ESA25301LA	ESA25101LA	ESA2-01	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA25401FR	ESA25101FR	ESA2-02	RADS	WASTREN - GJ	02/02/98
ESA25401LA	ESA25101LA	ESA2-01	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA25502FR	ESA25101FR	ESA2-02	RADS	WASTREN - GJ	02/02/98
ESA25502LA	ESA25101LA	ESA2-01	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA25601FR	ESA22601FR	ESA2-06	RADS	WASTREN - GJ	02/02/98
ESA25601LA	ESA25601LA	ESA2-05	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA25701FR	ESA22601FR	ESA2-06	RADS	WASTREN - GJ	02/02/98
ESA25701LA	ESA25601LA	ESA2-05	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA25801FR	ESA22601FR	ESA2-06	RADS	WASTREN - GJ	02/02/98
ESA25801LA	ESA25601LA	ESA2-05	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA25901FR	ESA22601FR	ESA2-06	RADS	WASTREN - GJ	02/02/98
ESA25901LA	ESA25601LA	ESA2-05	METALS - (TAL)	WASTREN - GJ	02/02/98
ESA26002FR	ESA22601FR	ESA2-06	RADS	WASTREN - GJ	02/02/98
ESA26002LA	ESA25601LA	ESA2-05	METALS - (TAL)	WASTREN - GJ	02/02/98

ECOLOGICAL STUDY AREA - BIOTIC SAMPLES - INORGANIC DATA

AREA	CPP PLUME AREA	CPP PLUME AREA	CPP PLUME AREA	CPP PLUME AREA	CPP PLUME AREA
LOCATION	ESA - #1	ESA - #2	ESA - #3	ESA - #4	ESA - #5
TYPE OF LOCATION	VEG. TYPE 1	VEG. TYPE 1	VEG. TYPE 1	VEG. TYPE 1	VEG. TYPE 1
SAMPLE NUMBER	ESA20101LA	ESA20201LA	ESA20301LA	ESA20401LA	ESA20501LA
MEDIA	PLANT BIOTA	PLANT BIOTA	PLANT BIOTA	PLANT BIOTA	PLANT BIOTA
UNITS	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
SDG NUMBER	ESA20101LA	ESA20101LA	ESA20101LA	ESA20101LA	ESA20101LA
FIELD MEASUREMENT					
Depth (ft)	N/A	N/A	N/A	N/A	N/A
ANALYTES					
Aluminum	53.1 NJ	159 NJ	53.8 NJ	49.2 NJ	150 NJ
Antimony	0.01 R	0.01 R	0.01 R	0.01 R	0.01 R
Arsenic	0.08 NJ	0.13 NJ	0.12 NJ	0.09 NJ	0.16 NJ
Barium	9.6	44.2	14.7	13.0	15.4
Beryllium	0.01 U	0.01 U	0.01 U	0.01 U	0.01
Cadmium	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U
Calcium	1.8	4.0	1.7	1.7	3.9
Chromium	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U
Cobalt	1.5 U	1.8 U	2.6	2.5	2.0 U
Copper					
Cyanide					
Iron	0.11 U	0.22 U	0.16 U	0.20 U	0.22 U
Lead	16.9	21.5	23.7	18.7	22.9
Magnesium	0.01 R	0.03 R	0.01 R	0.01 R	0.01 R
Manganese	0.75	1.9	0.75	1.1	1.7
Mercury	0.03	0.07	0.48	0.29	0.11
Nickel	0.01 U	0.01 U	0.01 U	0.01 U	0.01
Potassium					
Selenium	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Silver	0.22 U	0.38	0.22 U	0.22 U	0.38
Sodium	11.4	12.1	24.7	15.8	18.4
Thallium					
Vanadium	4.3	3.8	3.0	2.7	3.0
Zinc	0.70	0.67	0.70	0.53	0.78
Tin	8.5	10.4	11.2	8.8	11.3
Boron					
Molybdenum					
Strontium					
% Solids	63.2	68.0	59.7	69.6	69.2
Total (Allowed) Hold Time[a]	103(180)d	103(180)d	103(180)d	102(180)d	102(180)d
Total (Allowed) Hold Time[b]	91(28)d*	91(28)d*	91(28)d*	90(28)d*	124(28)d*

a. ICP/HGAA
b. CVAAS

5-28-98

ECOLOGICAL STUDY AREA - BIOTIC SAMPLES - INORGANIC DATA (Continued)

AREA	CPP PLUME AREA	CPP PLUME AREA	CPP PLUME AREA	CPP PLUME AREA	CPP PLUME AREA
LOCATION	ESA - #5	ESA - #1	ESA - #2	ESA - #3	ESA - #4
TYPE OF LOCATION	VEG. TYPE 1	VEG. TYPE 2	VEG. TYPE 2	VEG. TYPE 2	VEG. TYPE 2
SAMPLE NUMBER	ESA20502LA	ESA20601LA	ESA20701LA	ESA20801LA	ESA20901LA
MEDIA	PLANT BIOTA	PLANT BIOTA	PLANT BIOTA	PLANT BIOTA	PLANT BIOTA
UNITS	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
SDG NUMBER	ESA20101LA	ESA20601LA	ESA20601LA	ESA20601LA	ESA20601LA
FIELD MEASUREMENT					
Depth (ft)	N/A	N/A	N/A	N/A	N/A
ANALYTES					
Aluminum	64.5 NJ	135	85.0	75.9	69.5
Antimony	0.01 R	0.02	0.01	0.01 U	0.01 U
Arsenic	0.07 NJ	0.18	0.18	0.17	0.17
Barium	3.6	5.2	5.0	5.4	5.1
Beryllium	0.01 U	0.01	0.01 U	0.01 U	0.01 U
Cadmium	0.07 U	0.10	0.12	0.14	0.10
Calcium	2.7	0.61	0.44	0.32	0.39
Chromium	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U
Cobalt	1.8 U	5.8	4.9	7.7	7.3
Copper					
Cyanide					
Iron	0.08 U	0.18	0.13	0.15	0.20
Lead	11.8	16.7	19.7	16.2	13.8
Magnesium	0.01 R	0.01 R	0.04 R	0.04 R	0.02 R
Manganese	1.2	0.74	0.59	0.75	0.58
Mercury	0.18	0.12 NEJ	0.07 NEJ	0.38 NEJ	0.53 NEJ
Nickel	0.01 U	0.02 U	0.02 U	0.02 U	0.02 U
Potassium	0.01 U	0.01	0.01 U	0.01	0.01
Selenium	0.22 U	0.35	0.22	0.21	0.16
Silver	12.7	15.2 NJ	12.9 NJ	19.9 NJ	17.6 NJ
Sodium					
Thallium					
Vanadium					
Zinc					
Tin					
Boron	2.6	12.3	16.7	15.4	11.4
Molybdenum	0.76	0.22	0.22	0.32	0.25
Strontium	6.7	12.2	13.7	11.1	11.0
% Solids	64.5	54.9	52.6	52.3	55.9
Total (Allowed) Hold Time[a]	102(180)d	99(180)d	99(180)d	99(180)d	98(180)d
Total (Allowed) Hold Time[b]	90(28)d*	91(28)d*	91(28)d*	91(28)d*	90(28)d*

a. ICP/HGAA
b. CVAAS

5-28-98

ECOLOGICAL STUDY AREA - BIOTIC SAMPLES - INORGANIC DATA (Continued)

AREA	CPP PLUME AREA	CPP PLUME AREA	CPP PLUME AREA	CPP PLUME AREA	CPP PLUME AREA
LOCATION	ESA - #5	ESA - #5	ESA - #1	ESA - #2	ESA - #3
TYPE OF LOCATION	VEG. TYPE 2	VEG. TYPE 2	INVERTEBRATE 1	INVERTEBRATE 1	INVERTEBRATE 1
SAMPLE NUMBER	ESA21001LA	ESA21002LA	ESA22101LA	ESA22201LA	ESA22301LA
MEDIA	PLANT BIOTA	PLANT BIOTA	ANIMAL BIOTA	ANIMAL BIOTA	ANIMAL BIOTA
UNITS	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
SDG NUMBER	ESA20601LA	ESA20601LA	ESA25101LA	ESA25101LA	ESA25101LA
FIELD MEASUREMENT					
Depth (ft)	N/A	N/A	N/A	N/A	N/A
ANALYTES					
Aluminum	77.2	80.6	207 J	176 J	232 J
Antimony	0.01 U	0.01 U	0.04	0.02 U	0.02 U
Arsenic	0.21	0.17	0.53 E	0.48 E	0.60 E
Barium	5.6	5.1	8.2	7.4	10.5
Beryllium	0.01 U	0.01	0.02 U	0.02 U	0.02 U
Cadmium	0.25	0.13	0.14	0.14	0.17
Calcium					
Chromium	0.39	0.30	3.0	1.3	1.7
Cobalt	0.14 U	0.14 U	0.22	0.16	0.22
Copper	8.0	7.2	8.5	6.4	8.1
Cyanide					
Iron					
Lead	0.14	0.11	0.95	0.70	0.33 U
Magnesium					
Manganese	16.1	12.6	13.5	12.2	14.3
Mercury	0.02 R	0.01 R	0.02	0.02	0.02
Nickel	0.66	0.47	1.7	0.72 U	1.0
Potassium					
Selenium	0.28 NEJ	0.25 NEJ	0.05	0.04	0.19
Silver	0.02 U	0.02 U	0.01 U	0.01 U	0.01
Sodium					
Thallium	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Vanadium	0.11	0.19	0.55	0.41	0.70
Zinc	22.4 NJ	19.1 NJ	49.3	31.9	35.8
Tin					
Boron	13.9	10.4	7.3	5.1	4.1
Molybdenum	0.33	0.22	0.58	0.38	0.58
Strontium	12.4	10.4	8.0	6.7	5.6
% Solids	56.5	55.2	41.4	38.2	37.8
Total (Allowed) Hold Time[a]	98(180)d	98(180)d	33(180)d	33(180)d	33(180)d
Total (Allowed) Hold Time[b]	90(28)d*	90(28)d*	20(28)d	20(28)d	20(28)d

a. ICP/HGAA
b. CVAAS

5-28-98

ECOLOGICAL STUDY AREA - BIOTIC SAMPLES - INORGANIC DATA (Continued)

AREA	CPP PLUME AREA	CPP PLUME AREA	CPP PLUME AREA	CPP PLUME AREA	CPP PLUME AREA
LOCATION	ESA - #4	ESA - #5	ESA - #1	ESA - #2	ESA - #3
TYPE OF LOCATION	INVERTEBRATE 1	INVERTEBRATE 1	INVERTEBRATE 2	INVERTEBRATE 2	INVERTEBRATE 2
SAMPLE NUMBER	ESA22401LA	ESA22501LA	ESA22601LA	ESA22701LA	ESA22801LA
MEDIA	ANIMAL BIOTA	ANIMAL BIOTA	ANIMAL BIOTA	ANIMAL BIOTA	ANIMAL BIOTA
UNITS	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
SDG NUMBER	ESA25101LA	ESA25101LA	ESA25601LA	ESA25601LA	ESA25601LA
FIELD MEASUREMENT					
Depth (ft)	N/A	N/A	N/A	N/A	N/A
ANALYTES					
Aluminum	198 J	249 J	250	251	228
Antimony	0.02 U	0.02 U	0.02 NUJ	0.02 NUJ	0.02 NUJ
Arsenic	0.66 E	0.57 E	0.28 NJ	0.24 NJ	0.22 NJ
Barium	11.2	9.6	6.6 U	6.6 U	6.6 U
Beryllium	0.02 U	0.02 U	0.01	0.01	0.01
Cadmium	0.21	0.17	0.08	0.13	0.10
Calcium					
Chromium	1.5	2.1	0.86	0.91	0.96
Cobalt	0.20	0.22	0.18 U	0.40	0.18 U
Copper	7.6	7.2	19.4	22.8	24.9
Cyanide					
Iron					
Lead	0.36 U	0.31 U	0.30	0.25	0.22
Magnesium					
Manganese	15.4	13.7	9.0	9.6	7.8
Mercury	0.03	0.03	0.01 J	0.02 J	0.01 J
Nickel	0.91	0.93	0.60	0.87	0.60
Potassium					
Selenium	0.22	0.16	0.25	0.21	0.60
Silver	0.01 U	0.02	0.02	0.02	0.03
Sodium					
Thallium	0.01 U	0.01 U	0.01	0.01	0.01
Vanadium	0.58	0.75	0.76	0.66	0.76
Zinc	35.3	33.3	53.2	53.1	65.6
Tin					
Boron	4.1	3.7	1.4	4.2	1.8
Molybdenum	0.60	0.65	0.62	0.58	0.61
Strontium	5.1	4.7	3.6	5.4	3.5
% Solids	37.6	38.6	42.8	43.0	43.2
Total (Allowed) Hold Time[a]	33(180)d	33(180)d	51(180)d	51(180)d	51(180)d
Total (Allowed) Hold Time[b]	20(28)d	20(28)d	37(28)d*	37(28)d*	37(28)d*

a. ICP/HGAA
b. CVAAS

5-28-98

ECOLOGICAL STUDY AREA - BIOTIC SAMPLES - INORGANIC DATA (Continued)

AREA	CPP PLUME AREA	CPP PLUME AREA	REF. STUDY AREA	REF. STUDY AREA	REF. STUDY AREA
LOCATION	ESA - #4	ESA - #5	RSA - #1	RSA - #2	RSA - #3
TYPE OF LOCATION	INVERTEBRATE 2	INVERTEBRATE 2	VEG. TYPE 1	VEG. TYPE 1	VEG. TYPE 1
SAMPLE NUMBER	ESA22901LA	ESA23001LA	ESA23101LA	ESA23201LA	ESA23301LA
MEDIA	ANIMAL BIOTA	ANIMAL BIOTA	PLANT BIOTA	PLANT BIOTA	PLANT BIOTA
UNITS	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
SDG NUMBER	ESA25601LA	ESA25601LA	ESA20101LA	ESA20101LA	ESA20101LA
FIELD MEASUREMENT					
Depth (ft)	N/A	N/A	N/A	N/A	N/A
ANALYTES					
Aluminum	319	307	142 NJ	120 NJ	130 NJ
Antimony	0.02 NUJ	0.02 NUJ	0.01 R	0.01 R	0.01 R
Arsenic	0.23 NJ	0.28 NJ	0.14 NJ	0.15 NJ	0.09 NJ
Barium	6.7	6.6 U	12.3	12.2	11.9
Beryllium	0.02	0.01	0.01 U	0.01 U	0.01 U
Cadmium	0.12	0.10	0.01 U	0.07 U	0.07 U
Calcium					
Chromium	1.2	1.2	2.2	2.6	2.9
Cobalt	0.18 U	0.18 U	0.14 U	0.14 U	0.14 U
Copper	22.9	21.9	1.7 U	1.7 U	1.6 U
Cyanide					
Iron					
Lead	0.35	0.31	0.17 U	0.13 U	0.33 U
Magnesium					
Manganese	8.8	9.2	27.0	27.6	24.3
Mercury	0.01 J	0.01 J	0.01 R	0.01 R	0.01 R
Nickel	0.82	0.77	1.0	1.3	1.4
Potassium					
Selenium	0.68	0.51	0.05	0.03	0.09
Silver	0.03	0.03	0.01	0.01	0.01
Sodium					
Thallium	0.01	0.01	0.01 U	0.01 U	0.01 U
Vanadium	0.92	0.93	0.25	0.25	0.30
Zinc	63.9	56.3	7.8	6.7	7.9
Tin					
Boron	1.3	1.4	7.4	9.6	7.6
Molybdenum	0.54	0.64	0.97	1.2	0.98
Strontium	3.1	3.6	9.2	13.7	11.9
% Solids	43.5	43.6	54.0	55.6	57.4
Total (Allowed) Hold Time[a]	51(180)d	51(180)d	97(180)d	101(180)d	101(180)d
Total (Allowed) Hold Time[b]	37(28)d*	37(28)d*	85(28)d*	89(28)d*	89(28)d*

a. ICP/HGAA
b. CVAAS

5-28-98

ECOLOGICAL STUDY AREA - BIOTIC SAMPLES - INORGANIC DATA (Continued)

AREA	REF. STUDY AREA	REF. STUDY AREA	REF. STUDY AREA	REF. STUDY AREA	REF. STUDY AREA
LOCATION	RSA - #4	RSA - #5	RSA - #5	RSA - #1	RSA - #2
TYPE OF LOCATION	VEG. TYPE 1	VEG. TYPE 1	VEG. TYPE 1	VEG. TYPE 2	VEG. TYPE 2
SAMPLE NUMBER	ESA23401LA	ESA23501LA	ESA23502LA	ESA23601LA	ESA23701LA
MEDIA	PLANT BIOTA	PLANT BIOTA	PLANT BIOTA	PLANT BIOTA	PLANT BIOTA
UNITS	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
SDG NUMBER	ESA20101LA	ESA20101LA	ESA20101LA	ESA20601LA	ESA20601LA
FIELD MEASUREMENT					
Depth (ft)	N/A	N/A	N/A	N/A	N/A
ANALYTES					
Aluminum	94.5 NJ	128 NJ	126 NJ	60.9	49.5
Antimony	0.01 R	0.01 R	0.01 R	0.01 U	0.01 U
Arsenic	0.12 NJ	0.11 NJ	0.08 NJ	0.16	0.19
Barium	7.6	12.4	12.3	4.1	4.4
Beryllium	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Cadmium	0.07 U	0.07 U	0.07 U	0.08 U	0.08 U
Calcium					
Chromium	2.6	2.4	2.2	0.17	0.22
Cobalt	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U
Copper	1.5 U	1.6 U	1.4 U	4.0	5.9
Cyanide					
Iron					
Lead	0.15 U	0.17 U	0.21 U	0.11	0.13
Magnesium					
Manganese	25.7	28.4	23.8	18.2	17.0
Mercury	0.01 R	0.01 R	0.01 R	0.01 R	0.01 R
Nickel	1.2	1.1	0.95	0.44 U	0.44 U
Potassium					
Selenium	0.02	0.01	0.01	0.05 NEJ	0.04 NEJ
Silver	0.01	0.01	0.01	0.02 U	0.02 U
Sodium					
Thallium	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Vanadium	0.22 U	0.26	0.29	0.14	0.12
Zinc	6.8	9.3	9.7	11.7 NJ	13.6 NJ
Tin					
Boron	8.2	6.0	5.7	21.5	19.2
Molybdenum	1.0	0.79	0.66	0.35	0.70
Strontium	9.8	9.7	9.5	9.3	15.5
% Solids	52.2	56.0	54.4	45.5	49.2
Total (Allowed) Hold Time[a]	102(180)d	97(180)d	97(180)d	93(180)d	97(180)d
Total (Allowed) Hold Time[b]	90(28)d*	85(28)d*	85(28)d*	85(28)d*	89(28)d*

a. ICP/HGAA
b. CVAAS

5-28-98

ECOLOGICAL STUDY AREA - BIOTIC SAMPLES - INORGANIC DATA (Continued)

AREA	REF. STUDY AREA	REF. STUDY AREA	REF. STUDY AREA	REF. STUDY AREA	REF. STUDY AREA
LOCATION	RSA - #3	RSA - #4	RSA - #5	RSA - #1	RSA - #2
TYPE OF LOCATION	VEG. TYPE 2	VEG. TYPE 2	VEG. TYPE 2	INVERTEBRATE 1	INVERTEBRATE 1
SAMPLE NUMBER	ESA23801LA	ESA23901LA	ESA24001LA	ESA25101LA	ESA25201LA
MEDIA	PLANT BIOTA	PLANT BIOTA	PLANT BIOTA	ANIMAL BIOTA	ANIMAL BIOTA
UNITS	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
SDG NUMBER	ESA20601LA	ESA20601LA	ESA20601LA	ESA25101LA	ESA25101LA
FIELD MEASUREMENT					
Depth (ft)	N/A	N/A	N/A	N/A	N/A
ANALYTES					
Aluminum	70.8	66.4	49.1	539 J	420 J
Antimony	0.01 U	0.01 U	0.01 U	0.02 U	0.02 U
Arsenic	0.19	0.13 U	0.15	0.57 E	0.52 E
Barium	5.5	4.6	4.4	8.6	7.0
Beryllium	0.01 U	0.01 U	0.01 U	0.02	0.02
Cadmium	0.10	0.08 U	0.08 U	0.09	0.01
Calcium					
Chromium	0.22	0.20	0.22	2.2	2.2
Cobalt	0.14 U	0.14 U	0.14 U	0.29	0.30
Copper	6.2	5.7	5.2	7.8	8.5
Cyanide					
Iron					
Lead	0.23	0.13	0.21	0.48 U	0.43 U
Magnesium					
Manganese	19.6	22.8	21.4	23.0	19.1
Mercury	0.01 R	0.01 R	0.01 R	0.02 J	0.04 J
Nickel	0.45	0.44 U	0.44 U	0.89	0.94
Potassium					
Selenium	0.01 NEJ	0.04 NEJ	0.02 NEJ	0.04	0.04
Silver	0.02 U	0.02 U	0.02 U	0.03	0.03
Sodium					
Thallium	0.01 U	0.01 U	0.01 U	0.01	0.01
Vanadium	0.17	0.14	0.08 U	1.2	0.99
Zinc	11.8 NJ	10.0 NJ	9.9 NJ	24.2	26.7
Tin					
Boron	27.2	20.1	22.2	3.1	3.7
Molybdenum	0.29	0.55	0.29	0.58	0.54
Strontium	15.3	13.7	12.6	5.4	6.5
% Solids	51.1	50.0	49.7	36.8	37.2
Total (Allowed) Hold Time[a]	97(180)d	98(180)d	93(180)d	55(180)d	55(180)d
Total (Allowed) Hold Time[b]	89(28)d*	90(28)d*	85(28)d*	42(28)d*	42(28)d*

a. ICP/HGAA
b. CVAAS

5-28-98

ECOLOGICAL STUDY AREA - BIOTIC SAMPLES - INORGANIC DATA (Continued)

AREA	REF. STUDY AREA	REF. STUDY AREA	REF. STUDY AREA	REF. STUDY AREA	REF. STUDY AREA
LOCATION	RSA - #3	RSA - #4	RSA - #5	RSA - #1	RSA - #2
TYPE OF LOCATION	INVERTEBRATE 1	INVERTEBRATE 1	INVERTEBRATE 1	INVERTEBRATE 2	INVERTEBRATE 2
SAMPLE NUMBER	ESA25301LA	ESA25401LA	ESA25502LA	ESA25601LA	ESA25701LA
MEDIA	ANIMAL BIOTA	ANIMAL BIOTA	ANIMAL BIOTA	ANIMAL BIOTA	ANIMAL BIOTA
UNITS	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
SDG NUMBER	ESA25101LA	ESA25101LA	ESA25101LA	ESA25601LA	ESA25601LA
FIELD MEASUREMENT					
Depth (ft)	N/A	N/A	N/A	N/A	N/A
ANALYTES					
Aluminum	387 J	432 J	493 J	254	329
Antimony	0.02 U	0.02 U	0.02 U	0.02 NUJ	0.02 NUJ
Arsenic	0.38 E	0.40 E	0.38 E	0.45 NJ	0.32 NJ
Barium	6.9	7.0	7.7	6.6 U	6.6 U
Beryllium	0.02	0.02 U	0.02	0.01	0.02
Cadmium	0.11	0.10	0.11	0.05	0.05
Calcium					
Chromium	1.7	1.9	2.0	1.3	1.9
Cobalt	0.34	0.19	0.27	0.20	0.29
Copper	8.9	7.8	8.0	13.2	19.0
Cyanide					
Iron					
Lead	0.38 U	0.45 U	0.53 U	0.24	0.46
Magnesium					
Manganese	17.9	19.4	20.1	9.4	12.6
Mercury	0.04 J	0.03 J	0.04 J	0.01 UJ	0.01 UJ
Nickel	0.75 U	0.89	0.91	0.48	0.79
Potassium					
Selenium	0.04	0.04	0.04	0.10	0.11
Silver	0.03	0.03	0.03	0.02	0.02
Sodium					
Thallium	0.01	0.01	0.01	0.01	0.01
Vanadium	0.78	0.90	0.99	0.61	0.89
Zinc	26.0	26.3	23.4	40.4	50.3
Tin					
Boron	3.8	3.7	3.3	1.4	2.3
Molybdenum	0.48	0.49	0.41	0.57	0.61
Strontium	6.8	6.1	5.8	2.1	4.5
% Solids	36.0	37.1	35.9	33.0	33.7
Total (Allowed) Hold Time[a]	55(180)d	55(180)d	55(180)d	56(180)d	56(180)d
Total (Allowed) Hold Time[b]	42(28)d*	42(28)d*	42(28)d*	42(28)d*	42(28)d*

a. ICP/HGAA
b. CVAAS

5-28-98

ECOLOGICAL STUDY AREA - BIOTIC SAMPLES - INORGANIC DATA (Continued)

AREA	REF. STUDY AREA	REF. STUDY AREA	REF. STUDY AREA
LOCATION	RSA - #3	RSA - #4	RSA - #5
TYPE OF LOCATION	INVERTEBRATE 2	INVERTEBRATE 2	INVERTEBRATE 2
SAMPLE NUMBER	ESA25801LA	ESA25901LA	ESA26002LA
MEDIA	ANIMAL BIOTA	ANIMAL BIOTA	ANIMAL BIOTA
UNITS	mg/kg	mg/kg	mg/kg
SDG NUMBER	ESA25601LA	ESA25601LA	ESA25601LA
FIELD MEASUREMENT			
Depth (ft)	N/A	N/A	N/A
ANALYTES			
Aluminum	422	339	404
Antimony	0.02 NUJ	0.02 NUJ	0.02 NUJ
Arsenic	0.26 NJ	0.24 NJ	0.28 NJ
Barium	6.6 U	6.6 U	6.6 U
Beryllium	0.02	0.02	0.01
Cadmium	0.10	0.05	0.05
Calcium			
Chromium	2.0	0.81	1.2
Cobalt	0.30	0.22	0.32
Copper	21.8	18.8	19.0
Cyanide			
Iron			
Lead	0.37	0.33	0.32
Magnesium			
Manganese	13.6	10.9	12.6
Mercury	0.01 UJ	0.01 J	0.01 UJ
Nickel	0.70	0.39	0.68
Potassium			
Selenium	0.11	0.13	0.11
Silver	0.02	0.02	0.02
Sodium			
Thallium	0.01	0.01	0.01
Vanadium	1.1	0.73	0.91
Zinc	40.8	38.6	44.9
Tin			
Boron	1.8	1.7	2.8
Molybdenum	0.58	0.60	0.49
Strontium	3.0	2.5	3.3
% Solids	33.5	33.1	33.6
Total (Allowed) Hold Time[a]	56(180)d	56(180)d	56(180)d
Total (Allowed) Hold Time[b]	42(28)d*	42(28)d*	42(28)d*

a. ICP/HGAA
b. CVAAS

5-28-98

ECOLOGICAL STUDY AREA - BIOTIC SAMPLES - ANALYSIS RESULTS FOR RADIONUCLIDE DATA

AREA	CPP PLUME AREA ESA - #1		CPP PLUME AREA ESA - #2		CPP PLUME AREA ESA - #3		CPP PLUME AREA ESA - #4		CPP PLUME AREA ESA - #5	
LOCATION	VEG. TYPE 1		VEG. TYPE 1		VEG. TYPE 1		VEG. TYPE 1		VEG. TYPE 1	
TYPE OF LOCATION	ESA20101FR		ESA20201FR		ESA20301FR		ESA20401FR		ESA20501FR	
SAMPLE NUMBER	PLANT BIOTA	D	PLANT BIOTA	D	PLANT BIOTA	D	PLANT BIOTA	D	PLANT BIOTA	D
MEDIA	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q
UNITS	ESA20101FR	F	ESA20101FR	F	ESA20101FR	F	ESA20101FR	F	ESA20101FR	F
SDG NUMBER										
FIELD MEASUREMENT Depth (ft)	N/A		N/A		N/A		N/A		N/A	
Gross Alpha	1.40E-01 ± 1.80E-01	U	1.80E-01 ± 2.10E-01	U	2.10E-01 ± 2.10E-01	U	1.50E-01 ± 2.00E-01	U	2.60E-01 ± 2.30E-01	U
Gross Beta	4.55E+00 ± 5.20E-01		5.47E+00 ± 5.80E-01		5.20E+00 ± 5.30E-01		5.09E+00 ± 5.70E-01		4.77E+00 ± 5.60E-01	
Alpha Emitters										
Americium - 241	0.00E+00 ± 7.60E-01	U	0.00E+00 ± 1.15E+00	U	0.00E+00 ± 9.10E-01	U	0.00E+00 4.10E-01	U	0.00E+00 ± 4.50E-01	U
Plutonium - 238										
Plutonium - 239/240										
Uranium - 234										
Uranium - 235	0.00E+00 ± 3.34E+00	U	0.00E+00 ± 3.30E+00	U	0.00E+00 ± 2.11E+00	U	0.00E+00 3.14E-00	U	0.00E+00 3.22E+00	U
Uranium - 238										
Beta Emitters										
Protactinium - 23	0.00E+00 ± 8.50E-01	U	0.00E+00 ± 1.06E+00	U	0.00E+00 4.50E-01	U	0.00E+00 ± 7.20E-01	U	0.00E+00 7.00E-01	U
Strontium - 90							1.10E-01 ± 1.30E-01	U		
Gamma Emitters										
Antimony - 125	0.00E+00 ± 9.00E-01	U	0.00E+00 ± 1.69E+00	U	0.00E+00 ± 8.50E-01	U	0.00E+00 ± 1.40E+00	U	0.00E+00 ± 1.28E+00	U
Barium - 133	0.00E+00 ± 6.50E-01	U	0.00E+00 ± 8.60E-01	U	0.00E+00 ± 5.50E-01	U	0.00E+00 ± 6.30E-01	U	0.00E+00 ± 7.00E-01	U
Bismuth - 211	0.00E+00 ± 3.68E+00	U	0.00E+00 ± 4.63E+00	U	0.00E+00 ± 3.06E+00	U	0.00E+00 ± 3.48E+00	U	0.00E+00 ± 3.58E+00	U
Bismuth - 214	0.00E+00 ± 1.67E+00	U	0.00E+00 ± 1.72E+00	U	0.00E+00 ± 1.48E+00	U	0.00E+00 ± 2.06E+00	U	0.00E+00 ± 2.03E+00	U
Cadmium - 109	0.00E+00 ± 9.94E+00	U	0.00E+00 ± 1.05E+01	U	0.00E+00 ± 8.47E+00	U	0.00E+00 ± 1.08E+01	U	0.00E+00 ± 1.14E+01	U
Cerium - 144	0.00E+00 ± 2.60E+00	U	0.00E+00 ± 3.42E+00	U	0.00E+00 ± 2.71E+00	U	0.00E+00 ± 2.63E+00	U	0.00E+00 ± 3.41E+00	U
Cesium - 134	0.00E+00 ± 3.80E-01	U	0.00E+00 ± 1.90E-01	U	0.00E+00 ± 2.60E-01	U	0.00E+00 ± 1.40E-01	U	0.00E+00 ± 2.50E-01	U
Cesium - 137	0.00E+00 ± 6.20E-01	U	0.00E+00 ± 6.30E-01	U	0.00E+00 ± 4.40E-01	U	0.00E+00 ± 5.70E-01	U	0.00E+00 ± 5.80E-01	U
Cobalt - 57	0.00E+00 ± 3.30E-01	U	0.00E+00 ± 3.00E-01	U	0.00E+00 ± 3.00E-01	U	0.00E+00 ± 3.50E-01	U	0.00E+00 ± 4.20E-01	U
Cobalt - 58	0.00E+00 ± 2.20E-01	U	0.00E+00 ± 1.60E-01	U	0.00E+00 ± 4.30E-01	U	0.00E+00 ± 2.40E-01	U	0.00E+00 ± 3.70E-01	U
Cobalt - 60	0.00E+00 ± 4.00E-01	U	0.00E+00 ± 5.70E-01	U	0.00E+00 ± 3.70E-01	U	0.00E+00 ± 5.90E-01	U	0.00E+00 ± 5.90E-01	U
Europium - 152	0.00E+00 ± 6.40E-01	U	0.00E+00 ± 3.49E+00	U	0.00E+00 ± 2.66E+00	U	0.00E+00 ± 3.23E+00	U	0.00E+00 ± 3.85E+00	U
Europium - 154	0.00E+00 ± 1.77E+00	U	0.00E+00 ± 1.60E+00	U	0.00E+00 ± 1.52E+00	U	0.00E+00 ± 7.40E-01	U	0.00E+00 ± 1.86E+00	U
Europium - 155	0.00E+00 ± 3.26E+00	U	0.00E+00 ± 1.71E+00	U	0.00E+00 ± 3.84E+00	U	0.00E+00 ± 3.87E+00	U	0.00E+00 ± 4.24E+00	U
Lead - 210	0.00E+00 ± 9.74E+00	U	0.00E+00 ± 1.09E+01	U	0.00E+00 ± 9.50E+00	U	0.00E+00 ± 1.14E+01	U	0.00E+00 ± 1.23E+01	U
Lead - 211	0.00E+00 ± 1.17E+01	U	0.00E+00 ± 1.00E+01	U	0.00E+00 ± 1.20E+01	U	0.00E+00 ± 8.35E+00	U	0.00E+00 ± 1.25E+01	U
Lead - 212	0.00E+00 ± 1.11E+00	U	0.00E+00 ± 1.03E+00	U	0.00E+00 ± 1.07E+00	U	0.00E+00 ± 1.10E+00	U	0.00E+00 ± 1.24E+00	U
Lead - 214	0.00E+00 ± 1.38E+00	U	0.00E+00 ± 1.64E+00	U	0.00E+00 ± 1.17E+00	U	0.00E+00 ± 1.22E+00	U	0.00E+00 ± 1.29E+00	U
Manganese - 54	0.00E+00 ± 4.70E-01	U	0.00E+00 ± 1.30E-01	U	0.00E+00 ± 4.90E-01	U	0.00E+00 ± 4.10E-01	U	0.00E+00 ± 3.70E-01	U
Niobium - 95	0.00E+00 ± 4.80E-01	U	0.00E+00 ± 4.60E-01	U	0.00E+00 ± 4.90E-01	U	0.00E+00 ± 4.80E-01	U	0.00E+00 ± 5.20E-01	U
Potassium - 40	0.00E+00 ± 6.49E+00	U	0.00E+00 ± 1.31E+01	U	0.00E+00 ± 1.10E+01	U	0.00E+00 ± 1.30E+01	U	0.00E+00 ± 1.46E+01	U
Radium - 226	0.00E+00 ± 1.16E+01	U	0.00E+00 ± 1.25E+01	U	0.00E+00 ± 1.09E+01	U	0.00E+00 ± 1.31E+01	U	0.00E+00 ± 1.51E+01	U
Ruthenium - 103	0.00E+00 ± 2.10E-01	U	0.00E+00 ± 3.90E-01	U	0.00E+00 ± 3.30E-01	U	0.00E+00 ± 3.70E-01	U	0.00E+00 ± 4.50E-01	U
Ruthenium - 106	0.00E+00 ± 6.01E+00	U	0.00E+00 ± 4.82E+00	U	0.00E+00 ± 3.97E+00	U	0.00E+00 ± 6.13E+00	U	0.00E+00 ± 5.16E+00	U
Silver - 108m	0.00E+00 ± 3.80E-01	U	0.00E+00 ± 6.40E-01	U	0.00E+00 ± 5.60E-01	U	0.00E+00 ± 3.00E-01	U	0.00E+00 ± 4.20E-01	U
Silver - 110m	0.00E+00 ± 5.90E-01	U	0.00E+00 ± 6.10E-01	U	0.00E+00 ± 4.60E-01	U	0.00E+00 ± 5.20E-01	U	0.00E+00 ± 5.70E-01	U
Sodium - 22	0.00E+00 ± 1.70E-01	U	0.00E+00 ± 4.80E-01	U	0.00E+00 ± 1.12E+00	U	0.00E+00 ± 4.20E-01	U	0.00E+00 ± 2.30E-01	U
Thallium - 208	0.00E+00 ± 7.00E-01	U	0.00E+00 ± 7.20E-01	U	0.00E+00 ± 5.60E-01	U	0.00E+00 ± 6.70E-01	U	0.00E+00 ± 8.00E-01	U
Thorium - 227	0.00E+00 ± 4.58E+00	U	0.00E+00 ± 4.17E+00	U	0.00E+00 ± 2.92E+00	U	0.00E+00 ± 4.45E+00	U	0.00E+00 ± 5.26E+00	U
Thorium - 234	0.00E+00 ± 1.06E+01	U	0.00E+00 ± 1.13E+01	U	0.00E+00 ± 9.57E+00	U	0.00E+00 ± 1.20E+01	U	0.00E+00 ± 1.21E+01	U
Zinc - 65	0.00E+00 ± 6.10E-01	U	0.00E+00 ± 1.13E+00	U	0.00E+00 ± 8.20E-01	U	0.00E+00 ± 8.50E-01	U	0.00E+00 ± 2.50E-01	U
Zirconium - 95	0.00E+00 ± 1.15E+00	U	0.00E+00 ± 1.29E+00	U	0.00E+00 ± 1.08E+00	U	0.00E+00 ± 1.11E+00	U	0.00E+00 ± 8.60E-01	U

a. The DQF column contains any data qualifier flags.

ECOLOGICAL STUDY AREA - BIOTIC SAMPLES - ANALYSIS RESULTS FOR RADIONUCLIDE DATA (Continued)

AREA	CPP PLUME AREA		CPP PLUME AREA		CPP PLUME AREA		CPP PLUME AREA		CPP PLUME AREA	
LOCATION	ESA - #5		ESA - #1		ESA - #2		ESA - #3		ESA - #4	
TYPE OF LOCATION	VEG. TYPE 1		VEG. TYPE 2		VEG. TYPE 2		VEG. TYPE 2		VEG. TYPE 2	
SAMPLE NUMBER	ESA20502FR		ESA20601FR		ESA20701FR		ESA20801FR		ESA20901FR	
MEDIA	PLANT BIOTA	D	PLANT BIOTA	D	PLANT BIOTA	D	PLANT BIOTA	D	PLANT BIOTA	D
UNITS	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q
SDG NUMBER	ESA20101FR	F	ESA20601FR	F	ESA20601FR	F	ESA20601FR	F	ESA20601FR	F
FIELD MEASUREMENT										
Depth (ft)	N/A		N/A		N/A		N/A		N/A	
Gross Alpha	1.10E-01 ± 1.80E-01	U	1.20E-01 ± 1.90E-01	U	2.90E-01 ± 2.40E-01	U	2.40E-01 ± 2.20E-01	U	3.00E-01 ± 2.50E-01	U
Gross Beta	5.05E+00 ± 5.50E-01		7.39E+00 ± 6.00E-01		6.88E+00 ± 5.60E-01		5.76E+00 ± 5.20E-01		6.76E+00 ± 5.80E-01	
Alpha Emitters										
Americium - 241	0.00E+00 ± 1.24E+00	U	0.00E+00 ± 4.70E-01	U	0.00E+00 ± 4.40E-01	U	0.00E+00 4.00E-01	U	0.00E+00 ± 4.80E-01	U
Plutonium - 238										
Plutonium - 239/240										
Uranium - 234										
Uranium - 235	0.00E+00 ± 2.96E+00	U	0.00E+00 ± 2.97E+00	U	0.00E+00 2.01E+00	U	0.00E+00 2.69E+00	U	0.00E+00 ± 2.33E+00	U
Uranium - 238										
Beta Emitters										
Protactinium - 233	0.00E+00 8.80E-01	U	0.00E+00 ± 7.00E-01	U	0.00E+00 ± 4.60E-01	U	0.00E+00 4.20E-01	U	0.00E+00 ± 7.60E-01	U
Strontium - 90										
Gamma Emitters										
Antimony - 125	0.00E+00 ± 1.16E+00	U	0.00E+00 ± 6.20E-01	U	0.00E+00 ± 1.02E+00	U	0.00E+00 ± 1.17E+00	U	0.00E+00 ± 1.38E+00	U
Barium - 133	0.00E+00 ± 7.00E-01	U	0.00E+00 ± 6.30E-01	U	0.00E+00 ± 4.60E-01	U	0.00E+00 ± 5.60E-01	U	0.00E+00 ± 5.30E-01	U
Bismuth - 211	0.00E+00 ± 3.73E+00	U	0.00E+00 ± 3.53E+00	U	0.00E+00 ± 2.76E+00	U	0.00E+00 ± 2.94E+00	U	0.00E+00 ± 2.90E+00	U
Bismuth - 214	0.00E+00 ± 1.80E+00	U	0.00E+00 ± 1.48E+00	U	0.00E+00 ± 1.25E+00	U	0.00E+00 ± 1.38E+00	U	0.00E+00 ± 1.39E+00	U
Cadmium - 109	0.00E+00 ± 1.08E+01	U	0.00E+00 ± 8.88E+00	U	0.00E+00 ± 7.64E+00	U	0.00E+00 ± 8.92E+00	U	0.00E+00 ± 1.01E+01	U
Cerium - 144	0.00E+00 ± 3.26E+00	U	0.00E+00 ± 2.43E+00	U	0.00E+00 ± 2.04E+00	U	0.00E+00 ± 1.64E+00	U	0.00E+00 ± 1.80E+00	U
Cesium - 134	0.00E+00 ± 5.20E-01	U	0.00E+00 ± 2.50E-01	U	0.00E+00 ± 3.40E-01	U	0.00E+00 ± 3.80E-01	U	0.00E+00 ± 3.40E-01	U
Cesium - 137	0.00E+00 ± 5.00E-01	U	0.00E+00 ± 4.40E-01	U	0.00E+00 ± 4.70E-01	U	0.00E+00 ± 4.10E-01	U	0.00E+00 ± 4.50E-01	U
Cobalt - 57	0.00E+00 ± 3.50E-01	U	0.00E+00 ± 3.30E-01	U	0.00E+00 ± 3.10E-01	U	0.00E+00 ± 2.60E-01	U	0.00E+00 ± 3.70E-01	U
Cobalt - 58	0.00E+00 ± 3.40E-01	U	0.00E+00 ± 3.50E-01	U	0.00E+00 ± 1.60E-01	U	0.00E+00 ± 2.30E-01	U	0.00E+00 ± 2.10E-01	U
Cobalt - 60	0.00E+00 ± 5.80E-01	U	0.00E+00 ± 4.00E-01	U	0.00E+00 ± 4.10E-01	U	0.00E+00 ± 3.70E-01	U	0.00E+00 ± 5.50E-01	U
Europium - 152	0.00E+00 ± 3.56E+00	U	0.00E+00 ± 2.25E+00	U	0.00E+00 ± 3.50E-01	U	0.00E+00 ± 1.24E+00	U	0.00E+00 ± 1.06E+00	U
Europium - 154	0.00E+00 ± 1.67E+00	U	0.00E+00 ± 1.33E+00	U	0.00E+00 ± 1.18E+00	U	0.00E+00 ± 1.50E+00	U	0.00E+00 ± 1.60E+00	U
Europium - 155	0.00E+00 ± 3.82E+00	U	0.00E+00 ± 3.30E+00	U	0.00E+00 ± 2.92E+00	U	0.00E+00 ± 3.50E+00	U	0.00E+00 ± 3.81E+00	U
Lead - 210	0.00E+00 ± 1.09E+01	U	0.00E+00 ± 8.03E+00	U	0.00E+00 ± 6.47E+00	U	0.00E+00 ± 7.82E+00	U	0.00E+00 ± 8.62E+00	U
Lead - 211	0.00E+00 ± 1.12E+01	U	0.00E+00 ± 7.52E+00	U	0.00E+00 ± 1.00E+01	U	0.00E+00 ± 1.32E+01	U	0.00E+00 ± 6.47E+00	U
Lead - 212	0.00E+00 ± 1.23E+00	U	0.00E+00 ± 9.20E-01	U	0.00E+00 ± 8.50E-01	U	0.00E+00 ± 9.30E-01	U	0.00E+00 ± 8.90E-01	U
Lead - 214	0.00E+00 ± 1.40E+00	U	0.00E+00 ± 1.27E+00	U	0.00E+00 ± 9.50E-01	U	0.00E+00 ± 1.05E+00	U	0.00E+00 ± 1.05E+00	U
Manganese - 54	0.00E+00 ± 5.10E-01	U	0.00E+00 ± 3.80E-01	U	0.00E+00 ± 2.40E-01	U	0.00E+00 ± 2.90E-01	U	0.00E+00 ± 3.90E-01	U
Niobium - 95	0.00E+00 ± 4.90E-01	U	0.00E+00 ± 4.70E-01	U	0.00E+00 ± 4.40E-01	U	0.00E+00 ± 3.60E-01	U	0.00E+00 ± 5.10E-01	U
Potassium - 40	0.00E+00 ± 1.35E+01	U	0.00E+00 ± 4.92E+00	U	0.00E+00 ± 4.80E+00	U	0.00E+00 ± 5.56E+00	U	0.00E+00 ± 4.64E+00	U
Radium - 226	0.00E+00 ± 1.19E+01	U	0.00E+00 ± 1.14E+01	U	0.00E+00 ± 8.97E+00	U	0.00E+00 ± 9.79E+00	U	0.00E+00 ± 1.00E+01	U
Ruthenium - 103	0.00E+00 ± 1.20E-01	U	0.00E+00 ± 3.80E-01	U	0.00E+00 ± 2.30E-01	U	0.00E+00 ± 1.70E-01	U	0.00E+00 ± 3.70E-01	U
Ruthenium - 106	0.00E+00 ± 5.13E+00	U	0.00E+00 ± 5.17E+00	U	0.00E+00 ± 4.31E+00	U	0.00E+00 ± 4.79E+00	U	0.00E+00 ± 4.92E+00	U
Silver - 108m	0.00E+00 ± 5.10E-01	U	0.00E+00 ± 1.40E-01	U	0.00E+00 ± 2.10E-01	U	0.00E+00 ± 1.10E-01	U	0.00E+00 ± 2.20E-01	U
Silver - 110m	0.00E+00 ± 4.60E-01	U	0.00E+00 ± 4.10E-01	U	0.00E+00 ± 4.80E-01	U	0.00E+00 ± 4.30E-01	U	0.00E+00 ± 4.60E-01	U
Sodium - 22	0.00E+00 ± 2.20E-01	U	0.00E+00 ± 2.40E-01	U	0.00E+00 ± 2.10E+00	U	0.00E+00 ± 5.10E-01	U	0.00E+00 ± 7.00E-02	U
Thallium - 208	0.00E+00 ± 7.40E-01	U	0.00E+00 ± 6.90E-01	U	0.00E+00 ± 5.00E-01	U	0.00E+00 ± 6.50E-01	U	0.00E+00 ± 6.00E-01	U
Thorium - 227	0.00E+00 ± 5.31E+00	U	0.00E+00 ± 3.69E+00	U	0.00E+00 ± 7.90E-01	U	0.00E+00 ± 3.95E+00	U	0.00E+00 ± 3.94E+00	U
Thorium - 234	0.00E+00 ± 1.19E+01	U	0.00E+00 ± 9.58E+00	U	0.00E+00 ± 8.58E+00	U	0.00E+00 ± 9.65E+00	U	0.00E+00 ± 1.15E+01	U
Zinc - 65	0.00E+00 ± 5.50E-01	U	0.00E+00 ± 6.20E-01	U	0.00E+00 ± 2.60E-01	U	0.00E+00 ± 6.70E-01	U	0.00E+00 ± 2.90E-01	U
Zirconium - 95	0.00E+00 ± 1.17E+00	U	0.00E+00 ± 9.80E-01	U	0.00E+00 ± 7.90E-01	U	0.00E+00 ± 8.00E-01	U	0.00E+00 ± 9.70E-01	U

a. The DQF column contains any data qualifier flags.

ECOLOGICAL STUDY AREA - BIOTIC SAMPLES - ANALYSIS RESULTS FOR RADIONUCLIDE DATA (Continued)

AREA	CPP PLUME AREA		CPP PLUME AREA		CPP PLUME AREA		CPP PLUME AREA		CPP PLUME AREA	
LOCATION	ESA - #5		ESA - #5		ESA - #1		ESA - #2		ESA - #3	
TYPE OF LOCATION	VEG. TYPE 2		VEG. TYPE 2		INVERTEBRATE 1		INVERTEBRATE 1		INVERTEBRATE 1	
SAMPLE NUMBER	ESA21001FR		ESA21002FR		ESA22101FR		ESA22201FR		ESA22301FR	
MEDIA	PLANT BIOTA	D	PLANT BIOTA	D	ANIMAL BIOTA	D	ANIMAL BIOTA	D	ANIMAL BIOTA	D
UNITS	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q
SDG NUMBER	ESA20601FR	F	ESA20601FR	F	ESA25101FR	F	ESA25101FR	F	ESA25101FR	F
FIELD MEASUREMENT										
Depth (ft)	N/A		N/A		N/A		N/A		N/A	
Gross Alpha	8.00E-02 ± 1.70E-01	U	1.00E-02 ± 1.40E-01	U	1.30E-01 ± 1.40E-01	U	1.70E-01 ± 1.50E-01	U	4.70E-01 ± 2.30E-01	
Gross Beta	6.27E+00 ± 5.60E-01		6.81E+00 ± 5.70E-01		3.90E+00 ± 3.80E-01		3.90E+00 ± 3.60E-01		3.41E+00 ± 3.40E-01	
Alpha Emitters										
Americium - 241	0.00E+00 ± 6.20E-01	U	0.00E+00 ± 5.0E-01	U	0.00E+00 ± 2.40E-01	U	0.00E+00 ± 2.60E-01	U	1.00E-03 ± 1.00E-03	U
Plutonium - 238									5.00E-04 ± 1.50E-03	U
Plutonium - 239,240									2.00E-03 ± 3.20E-03	U
Uranium - 234									1.20E-02 ± 6.00E-03	U
Uranium - 235	0.00E+00 ± 3.59E+00	U	0.00E+00 ± 2.11E+00	U	0.00E+00 ± 1.46E+00	U	0.00E+00 ± 1.09E+00	U	1.00E-03 ± 2.00E-03	U
Uranium - 238									1.20E-02 ± 6.00E-03	U
Beta Emitters										
Protactinium - 233	0.00E+00 ± 1.00E+00	U	0.00E+00 ± 5.50E-0	U	0.00E+00 ± 4.50E-01	U	0.00E+00 ± 3.80E-0	U	0.00E+00 ± 3.40E-01	U
Strontium - 90	0.00E+00 ± 1.00E-01	U							2.80E-01 ± 8.00E-02	
Gamma Emitters										
Antimony - 125	0.00E+00 ± 1.50E+00	U	0.00E+00 ± 9.80E-01	U	0.00E+00 ± 1.60E-01	U	0.00E+00 ± 3.80E-01	U	0.00E+00 ± 6.20E-01	U
Barium - 133	0.00E+00 ± 8.20E-01	U	0.00E+00 ± 4.70E-01	U	0.00E+00 ± 3.20E-01	U	0.00E+00 ± 2.60E-01	U	0.00E+00 ± 2.80E-01	U
Bismuth - 211	0.00E+00 ± 4.71E+00	U	0.00E+00 ± 2.32E+00	U	0.00E+00 ± 1.90E+00	U	0.00E+00 ± 1.49E+00	U	0.00E+00 ± 1.60E+00	U
Bismuth - 214	0.00E+00 ± 1.85E+00	U	0.00E+00 ± 1.11E+00	U	0.00E+00 ± 7.20E-01	U	0.00E+00 ± 6.00E-01	U	0.00E+00 ± 7.10E-01	U
Cadmium - 109	0.00E+00 ± 1.12E+01	U	0.00E+00 ± 7.51E+00	U	0.00E+00 ± 4.50E+00	U	0.00E+00 ± 4.06E+00	U	0.00E+00 ± 4.21E+00	U
Cerium - 144	0.00E+00 ± 2.47E+00	U	0.00E+00 ± 6.60E-01	U	0.00E+00 ± 7.80E-01	U	0.00E+00 ± 8.80E-01	U	0.00E+00 ± 9.00E-01	U
Cesium - 134	0.00E+00 ± 5.60E-01	U	0.00E+00 ± 2.70E-01	U	0.00E+00 ± 2.50E-01	U	0.00E+00 ± 1.80E-01	U	0.00E+00 ± 6.00E-02	U
Cesium - 137	0.00E+00 ± 6.40E-01	U	0.00E+00 ± 5.20E-01	U	0.00E+00 ± 2.40E-01	U	0.00E+00 ± 2.00E-01	U	0.00E+00 ± 2.20E-01	U
Cobalt - 57	0.00E+00 ± 2.60E-01	U	0.00E+00 ± 1.10E-01	U	0.00E+00 ± 1.30E-01	U	0.00E+00 ± 1.30E-01	U	0.00E+00 ± 1.10E-01	U
Cobalt - 58	0.00E+00 ± 1.70E-01	U	0.00E+00 ± 2.90E-01	U	0.00E+00 ± 1.30E-01	U	0.00E+00 ± 1.70E-01	U	0.00E+00 ± 1.50E-01	U
Cobalt - 60	0.00E+00 ± 3.10E-01	U	0.00E+00 ± 3.80E-01	U	0.00E+00 ± 2.80E-01	U	0.00E+00 ± 2.00E-01	U	0.00E+00 ± 2.60E-01	U
Europium - 152	0.00E+00 ± 1.09E+00	U	0.00E+00 ± 2.90E-01	U	0.00E+00 ± 1.40E-01	U	0.00E+00 ± 1.01E+00	U	0.00E+00 ± 1.05E+00	U
Europium - 154	0.00E+00 ± 1.58E+00	U	0.00E+00 ± 1.30E+00	U	0.00E+00 ± 7.20E-01	U	0.00E+00 ± 6.00E-01	U	0.00E+00 ± 7.20E-01	U
Europium - 155	0.00E+00 ± 3.64E+00	U	0.00E+00 ± 3.06E+00	U	0.00E+00 ± 1.61E+00	U	0.00E+00 ± 1.32E+00	U	0.00E+00 ± 1.78E+00	U
Lead - 210	0.00E+00 ± 7.93E+00	U	0.00E+00 ± 7.26E+00	U	0.00E+00 ± 3.89E+00	U	0.00E+00 ± 3.33E+00	U	0.00E+00 ± 3.62E+00	U
Lead - 211	0.00E+00 ± 1.43E+01	U	0.00E+00 ± 6.86E+00	U	0.00E+00 ± 5.46E+00	U	0.00E+00 ± 5.10E+00	U	0.00E+00 ± 5.13E+00	U
Lead - 212	0.00E+00 ± 1.33E+00	U	0.00E+00 ± 7.80E-01	U	0.00E+00 ± 4.30E-01	U	0.00E+00 ± 4.30E-01	U	0.00E+00 ± 4.70E-01	U
Lead - 214	0.00E+00 ± 1.56E+00	U	0.00E+00 ± 7.90E-01	U	0.00E+00 ± 6.20E-01	U	0.00E+00 ± 5.00E-01	U	0.00E+00 ± 5.30E-01	U
Manganese - 54	0.00E+00 ± 5.40E-01	U	0.00E+00 ± 3.00E-01	U	0.00E+00 ± 2.50E-01	U	0.00E+00 ± 1.50E-01	U	0.00E+00 ± 1.70E-01	U
Niobium - 95	0.00E+00 ± 6.60E-01	U	0.00E+00 ± 3.70E-01	U	0.00E+00 ± 2.50E-01	U	0.00E+00 ± 1.90E-01	U	0.00E+00 ± 1.80E-01	U
Potassium - 40	0.00E+00 ± 5.53E+00	U	0.00E+00 ± 3.77E+00	U	0.00E+00 ± 2.92E+00	U	0.00E+00 ± 1.88E+00	U	0.00E+00 ± 1.92E+00	U
Radium - 226	0.00E+00 ± 1.38E+01	U	0.00E+00 ± 6.84E+00	U	0.00E+00 ± 4.92E+00	U	0.00E+00 ± 3.76E+00	U	0.00E+00 ± 5.22E+00	U
Ruthenium - 103	0.00E+00 ± 4.70E-01	U	0.00E+00 ± 3.30E-01	U	0.00E+00 ± 6.00E-02	U	0.00E+00 ± 7.00E-02	U	0.00E+00 ± 1.90E-01	U
Ruthenium - 106	0.00E+00 ± 6.46E+00	U	0.00E+00 ± 3.95E+00	U	0.00E+00 ± 2.47E+00	U	0.00E+00 ± 2.09E+00	U	0.00E+00 ± 2.59E+00	U
Silver - 108m	0.00E+00 ± 2.00E-01	U	0.00E+00 ± 4.40E-01	U	0.00E+00 ± 2.80E-01	U	0.00E+00 ± 2.00E-01	U	0.00E+00 ± 1.90E-01	U
Silver - 110m	0.00E+00 ± 5.20E-01	U	0.00E+00 ± 4.80E-01	U	0.00E+00 ± 2.20E-01	U	0.00E+00 ± 1.90E-01	U	0.00E+00 ± 1.90E-01	U
Sodium - 22	0.00E+00 ± 1.30E-01	U	0.00E+00 ± 1.70E-01	U	0.00E+00 ± 2.10E-01	U	0.00E+00 ± 8.00E-02	U	0.00E+00 ± 4.50E-01	U
Thallium - 208	0.00E+00 ± 7.10E-01	U	0.00E+00 ± 5.10E-01	U	0.00E+00 ± 3.30E-01	U	0.00E+00 ± 2.80E-01	U	0.00E+00 ± 3.40E-01	U
Thorium - 227	0.00E+00 ± 5.85E+00	U	0.00E+00 ± 7.60E-01	U	0.00E+00 ± 1.93E+00	U	0.00E+00 ± 1.83E+00	U	0.00E+00 ± 2.06E+00	U
Thorium - 234	0.00E+00 ± 1.18E+01	U	0.00E+00 ± 8.13E+00	U	0.00E+00 ± 4.84E+00	U	0.00E+00 ± 4.69E+00	U	0.00E+00 ± 4.60E+00	U
Zinc - 65	0.00E+00 ± 5.40E-01	U	0.00E+00 ± 5.70E-01	U	0.00E+00 ± 1.10E-01	U	0.00E+00 ± 4.20E-01	U	0.00E+00 ± 3.30E-01	U
Zirconium - 95	0.00E+00 ± 8.80E-01	U	0.00E+00 ± 9.30E-01	U	0.00E+00 ± 5.20E-01	U	0.00E+00 ± 4.40E-01	U	0.00E+00 ± 4.50E-01	U

a. The DQF column contains any data qualifier flags.

ECOLOGICAL STUDY AREA - BIOTIC SAMPLES - ANALYSIS RESULTS FOR RADIONUCLIDE DATA (Continued)

AREA	CPP PLUME AREA		CPP PLUME AREA		CPP PLUME AREA		CPP PLUME AREA		CPP PLUME AREA	
LOCATION	ESA - #3		ESA - #4		ESA - #5		ESA - #1		ESA - #2	
TYPE OF LOCATION	INVERTEBRATE 1		INVERTEBRATE 1		INVERTEBRATE 1		INVERTEBRATE 2		INVERTEBRATE 2	
SAMPLE NUMBER	ESA22301FR-RE		ESA22401FR		ESA22501FR		ESA22601FR		ESA22701FR	
MEDIA	ANIMAL BIOTA	D	ANIMAL BIOTA	D	ANIMAL BIOTA	D	ANIMAL BIOTA	D	ANIMAL BIOTA	D
UNITS	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q
SDG NUMBER	ESA25101FR	F	ESA25101FR	F	ESA25101FR	F	ESA22601FR	F	ESA22601FR	F
FIELD MEASUREMENT										
Depth (ft)	N/A		N/A		N/A		N/A		N/A	
Gross Alpha	3.70E-01 ± 1.80E-01	U	3.10E-01 ± 1.90E-01	U	4.30E-01 ± 2.20E-01	U	2.80E-01 ± 2.00E-01	U	3.20E-01 ± 2.20E-01	U
Gross Beta	3.27E-00 ± 3.10E-01	U	3.40E+00 ± 3.40E-01		3.34E+00 ± 3.40E-01		5.37E+00 ± 4.50E-01		4.92E+00 ± 4.30E-01	
Alpha Emitters										
Americium - 241			0.00E+00 ± 2.00E-01	U	0.00E+00 ± 2.40E-01	U	0.00E+00 4.80E-01	U	0.00E+00 ± 4 '0E-01	U
Plutonium - 238										
Plutonium - 239,240										
Uranium - 234			0 00E 00 ± 19:+00	U	0 00E 00 ± 1 0E+00	U	0 00E 00 ± 2 56:+00	U	0.00E+00 ± 2.01E+00	U
Uranium - 235										
Uranium - 238										
Beta Emitters										
Protactinium - 233			0.00E+00 ± 3.30E-01	U	0.00E+00 ± 1.70E-01	U	0.00E+00 ± 6.40E-01	U	0 00E+00 ± 3 '0E 01	U
Strontium - 90							5.80E-01 ± 1.10E-01			
Gamma Emitters										
Antimony - 125			0.00E+00 ± 5.20E-01	U	0.00E+00 ± 4.30E-01	U	0.00E+00 ± 7.80E-01	U	0.00E+00 ± 8.40E-01	U
Barium - 133			0.00E+00 ± 3.20E-01	U	0.00E+00 ± 2.70E-01	U	0.00E+00 ± 5.20E-01	U	0.00E+00 ± 5.20E-01	U
Bismuth - 211			0.00E+00 ± 1.82E+00	U	0.00E+00 ± 1.49E+00	U	0.00E+00 ± 2.90E+00	U	0.00E+00 ± 2.98E+00	U
Bismuth - 214			0.00E+00 ± 7.10E-01	U	0.00E+00 ± 5.50E-01	U	0.00E+00 ± 1.68E+00	U	0.00E+00 ± 1.60E+00	U
Cadmium - 109			0.00E+00 ± 4.80E+00	U	0.00E+00 ± 3.63E+00	U	0.00E+00 ± 9.09E+00	U	0.00E+00 ± 8.29E+00	U
Cerium - 144			0.00E+00 ± 8.40E-01	U	0.00E+00 ± 8.40E-01	U	0.00E+00 ± 2.41E+00	U	0.00E+00 ± 2.59E+00	U
Cesium - 134			0.00E+00 ± 7.00E-02	U	0.00E+00 ± 4.00E-02	U	0.00E+00 ± 3.50E-01	U	0.00E+00 ± 2.10E-01	U
Cesium - 137			0.00E+00 ± 2.40E-01	U	0.00E+00 ± 2.30E-01	U	0.00E+00 ± 4.20E-01	U	0.00E+00 ± 4.40E-01	U
Cobalt - 57			0.00E+00 ± 1.60E-01	U	0.00E+00 ± 1.40E-01	U	0.00E+00 ± 2.80E-01	U	0.00E+00 ± 3.10E-01	U
Cobalt - 58			0.00E+00 ± 1.00E-01	U	0.00E+00 ± 7.00E-02	U	0.00E+00 ± 2.50E-01	U	0.00E+00 ± 1.50E-01	U
Cobalt - 60			0.00E+00 ± 2.80E-01	U	0.00E+00 ± 1.50E-01	U	0.00E+00 ± 3.80E-01	U	0.00E+00 ± 3.50E-01	U
Europium - 152			0.00E+00 ± 5.80E-01	U	0.00E+00 ± 4.30E-01	U	0.00E+00 ± 2.77E+00	U	0.00E+00 ± 2.54E+00	U
Europium - 154			0.00E+00 ± 5.60E-01	U	0.00E+00 ± 5.50E-01	U	0.00E+00 ± 1.41E+00	U	0.00E+00 ± 1.35E+00	U
Europium - 155			0.00E+00 ± 1.91E+00	U	0.00E+00 ± 1.42E+00	U	0.00E+00 ± 3.55E+00	U	0.00E+00 ± 3.34E+00	U
Lead - 210			0.00E+00 ± 4.00E+00	U	0.00E+00 ± 2.94E+00	U	0.00E+00 ± 9.20E+00	U	0.00E+00 ± 8.27E+00	U
Lead - 211			0.00E+00 ± 2.28E+00	U	0.00E+00 ± 2.29E+00	U	0.00E+00 ± 1.15E+01	U	0.00E+00 ± 1.15E+01	U
Lead - 212			0.00E+00 ± 4.40E-01	U	0.00E+00 ± 4.00E-01	U	0.00E+00 ± 7.90E-01	U	0.00E+00 ± 9.40E-01	U
Lead - 214			0.00E+00 ± 6.20E-01	U	0.00E+00 ± 5.20E-01	U	0.00E+00 ± 1.14E+00	U	0.00E+00 ± 1.08E+00	U
Manganese - 54			0.00E+00 ± 2.20E-01	U	0.00E+00 ± 8.00E-02	U	0.00E+00 ± 2.90E-01	U	0.00E+00 ± 3.50E-01	U
Niobium - 95			0.00E+00 ± 2.20E-01	U	0.00E+00 ± 2.00E-01	U	0.00E+00 ± 4.70E-01	U	0.00E+00 ± 3.60E-01	U
Potassium - 40			0.00E+00 ± 2.33E+00	U	0.00E+00 ± 2.29E+00	U	0.00E+00 ± 1.08E+01	U	0.00E+00 ± 1.04E+01	U
Radium - 226			0.00E+00 ± 4.94E+00	U	0.00E+00 ± 3.50E+00	U	0.00E+00 ± 1.05E+01	U	0.00E+00 ± 1.00E+01	U
Ruthenium - 103			0.00E+00 ± 1.50E-01	U	0.00E+00 ± 1.00E-01	U	0.00E+00 ± 3.50E-01	U	0.00E+00 ± 3.60E-01	U
Ruthenium - 106			0.00E+00 ± 2.48E+00	U	0.00E+00 ± 1.89E+00	U	0.00E+00 ± 4.82E+00	U	0.00E+00 ± 4.37E+00	U
Silver - 108m			0.00E+00 ± 2.90E-01	U	0.00E+00 ± 1.60E-01	U	0.00E+00 ± 3.20E-01	U	0.00E+00 ± 3.30E-01	U
Silver - 110m			0.00E+00 ± 1.90E-01	U	0.00E+00 ± 2.10E-01	U	0.00E+00 ± 4.90E-01	U	0.00E+00 ± 4.40E-01	U
Sodium - 22			0.00E+00 ± 9.00E-02	U	0.00E+00 ± 3.80E-01	U	0.00E+00 ± 8.40E-01	U	0.00E+00 ± 2.90E-01	U
Thallium - 208			0.00E+00 ± 3.00E-01	U	0.00E+00 ± 2.40E-01	U	0.00E+00 ± 5.20E-01	U	0.00E+00 ± 6.20E-01	U
Thorium - 227			0.00E+00 ± 5.50E-01	U	0.00E+00 ± 1.73E+00	U	0.00E+00 ± 3.48E+00	U	0.00E+00 ± 3.82E+00	U
Thorium - 234			0.00E+00 ± 5.50E+00	U	0.00E+00 ± 4.13E+00	U	0.00E+00 ± 1.05E+01	U	0.00E+00 ± 9.29E+00	U
Zinc - 65			0.00E+00 ± 4.00E-01	U	0.00E+00 ± 3.30E-01	U	0.00E+00 ± 4.60E-01	U	0.00E+00 ± 6.40E-01	U
Zirconium - 95			0.00E+00 ± 5.90E-01	U	0.00E+00 ± 3.60E-01	U	0.00E+00 ± 6.60E-01	U	0.00E+00 ± 9.80E-01	U

a. The DQF column contains any data qualifier flags.

ECOLOGICAL STUDY AREA - BIOTIC SAMPLES - ANALYSIS RESULTS FOR RADIONUCLIDE DATA (Continued)

AREA	UPP PLUME AREA		UPP PLUME AREA		UPP PLUME AREA		EF. STUDY AREA		STUDY AREA	
LOCATION	ESA - #3		ESA - #4		ESA - #5		RSA - #1		RSA - #2	
TYPE OF LOCATION	INVERTEBRATE 2		INVERTEBRATE 2		INVERTEBRATE 2		VEG. TYPE 1		VEG. TYPE 1	
SAMPLE NUMBER	ESA22801FR		ESA22901FR		ESA23001FR		ESA23101FR		ESA23201FR	
MEDIA	ANIMAL BIOTA	D	ANIMAL BIOTA	D	ANIMAL BIOTA	D	PLANT BIOTA	D	PLANT BIOTA	D
UNITS	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q
SDG NUMBER	ESA22601FR	F	ESA22601FR	F	ESA22601FR	F	ESA20101FR	F	ESA20101FR	F
FIELD MEASUREMENT										
Depth (ft)	N/A		N/A		N/A		N/A		N/A	
Gross Alpha	2.20E-01 ± 1.90E-01	U	2.00E-01 ± 1.80E-01	U	3.00E-01 ± 2.00E-01	U	4.00E-01 ± 2.50E-01	U	2.20E-01 ± 2.00E-01	U
Gross Beta	4.21E+00 ± 4.00E-01		4.03E+00 ± 4.00E-01		3.85E+00 ± 3.90E-01		3.55E+00 ± 4.30E-01		3.53E+00 ± 4.30E-01	
Alpha Emitters										
Americium - 241	0 10E 00 ± 50E-01	U	0.00E+00 ± 3 40E-01	U	0.00E+00 3.80E-01	U	0.00E+00 ± 2.70E-01	U	0 00E+00 3 20E-0	U
Plutonium - 238										
Plutonium - 239 :40										
Uranium - 234										
Uranium - 235	0.00E+00 ± 1.06E+00	U	0.00E+00 ± 1.92E+00	U	0.00E+00 ± 2 17E 00	U	0.00E+00 1 52E 00	U	0 00E+00 ± 1.46E+00	U
Uranium - 238										
Beta Emitters										
Protactinium - :35	0.00E+00 2.60E-01	U	0.00E+00 ± 2.80E-01	U	0.00E+00 6 50E-01	U	0.00E+00 ± 2.80E-01	U	0 00E+00 3.70E-01	U
Strontium - 90							7.00E-02 ± 9.00E-02	U		
Gamma Emitters										
Antimony - 125	0.00E+00 ± 4.70E-01	U	0.00E+00 ± 1.06E+00	U	0.00E+00 ± 8.80E-01	U	0.00E+00 ± 6.10E-01	U	0.00E+00 ± 2.40E-01	U
Barium - 133	0.00E+00 ± 2.20E-01	U	0.00E+00 ± 4.40E-01	U	0.00E+00 ± 4.90E-01	U	0.00E+00 ± 3.50E-01	U	0.00E+00 ± 3.30E-01	U
Bismuth - 211	0.00E+00 ± 1.17E+00	U	0.00E+00 ± 1.92E+00	U	0.00E+00 ± 2.82E+00	U	0.00E+00 ± 1.96E+00	U	0.00E+00 ± 1.80E+00	U
Bismuth - 214	0.00E+00 ± 5.60E-01	U	0.00E+00 ± 1.00E+00	U	0.00E+00 ± 1.16E+00	U	0.00E+00 ± 7.80E-01	U	0.00E+00 ± 7.80E-01	U
Cadmium - 109	0.00E+00 ± 3.76E+00	U	0.00E+00 ± 6.99E+00	U	0.00E+00 ± 7.10E+00	U	0.00E+00 ± 5.33E+00	U	0.00E+00 ± 5.94E+00	U
Cerium - 144	0.00E+00 ± 6.10E-01	U	0.00E+00 ± 1.90E+00	U	0.00E+00 ± 1.53E+00	U	0.00E+00 ± 7.90E-01	U	0.00E+00 ± 1.48E+00	U
Cesium - 134	0.00E+00 ± 6.00E-02	U	0.00E+00 ± 3.30E-01	U	0.00E+00 ± 2.30E-01	U	0.00E+00 ± 2.20E-01	U	0.00E+00 ± 6.00E-02	U
Cesium - 137	0.00E+00 ± 1.80E-01	U	0.00E+00 ± 4.20E-01	U	0.00E+00 ± 3.80E-01	U	0.00E+00 ± 2.80E-01	U	0.00E+00 ± 2.60E-01	U
Cobalt - 57	0.00E+00 ± 1.20E-01	U	0.00E+00 ± 1.70E-01	U	0.00E+00 ± 2.00E-01	U	0.00E+00 ± 1.70E-01	U	0.00E+00 ± 2.00E-01	U
Cobalt - 58	0.00E+00 ± 1.00E-01	U	0.00E+00 ± 1.90E-01	U	0.00E+00 ± 1.20E-01	U	0.00E+00 ± 6.00E-02	U	0.00E+00 ± 1.40E-01	U
Cobalt - 60	0.00E+00 ± 1.10E-01	U	0.00E+00 ± 3.60E-01	U	0.00E+00 ± 3.90E-01	U	0.00E+00 ± 2.70E-01	U	0.00E+00 ± 2.70E-01	U
Europium - 152	0.00E+00 ± 6.00E-01	U	0.00E+00 ± 5.00E-01	U	0.00E+00 ± 1.56E+00	U	0.00E+00 ± 4.30E-01	U	0.00E+00 ± 1.08E+00	U
Europium - 154	0.00E+00 ± 5.60E-01	U	0.00E+00 ± 6.50E-01	U	0.00E+00 ± 1.18E+00	U	0.00E+00 ± 7.80E-01	U	0.00E+00 ± 9.10E-01	U
Europium - 155	0.00E+00 ± 1.33E+00	U	0.00E+00 ± 2.98E+00	U	0.00E+00 ± 2.97E+00	U	0.00E+00 ± 2.05E+00	U	0.00E+00 ± 1.98E+00	U
Lead - 210	0.00E+00 ± 3.19E+00	U	0.00E+00 ± 6.78E+00	U	0.00E+00 ± 6.35E+00	U	0.00E+00 ± 4.40E+00	U	0.00E+00 ± 4.87E+00	U
Lead - 211	0.00E+00 ± 5.73E+00	U	0.00E+00 ± 9.23E+00	U	0.00E+00 ± 8.83E+00	U	0.00E+00 ± 5.48E+00	U	0.00E+00 ± 7.36E+00	U
Lead - 212	0.00E+00 ± 3.70E-01	U	0.00E+00 ± 6.60E-01	U	0.00E+00 ± 7.60E-01	U	0.00E+00 ± 5.00E-01	U	0.00E+00 ± 6.10E-01	U
Lead - 214	0.00E+00 ± 4.10E-01	U	0.00E+00 ± 7.10E-01	U	0.00E+00 ± 9.40E-01	U	0.00E+00 ± 7.00E-01	U	0.00E+00 ± 6.70E-01	U
Manganese - 54	0.00E+00 ± 1.10E-01	U	0.00E+00 ± 2.90E-01	U	0.00E+00 ± 1.00E-01	U	0.00E+00 ± 1.60E-01	U	0.00E+00 ± 1.80E-01	U
Niobium - 95	0.00E+00 ± 1.60E-01	U	0.00E+00 ± 3.00E-01	U	0.00E+00 ± 3.60E-01	U	0.00E+00 ± 2.30E-01	U	0.00E+00 ± 2.80E-01	U
Potassium - 40	0.00E+00 ± 1.75E+00	U	0.00E+00 ± 4.19E+00	U	0.00E+00 ± 3.76E+00	U	0.00E+00 ± 2.61E+00	U	0.00E+00 ± 3.27E+00	U
Radium - 226	0.00E+00 ± 3.08E+00	U	0.00E+00 ± 7.75E+00	U	0.00E+00 ± 7.56E+00	U	0.00E+00 ± 6.31E+00	U	0.00E+00 ± 6.21E+00	U
Ruthenium - 103	0.00E+00 ± 1.10E-01	U	0.00E+00 ± 2.10E-01	U	0.00E+00 ± 3.20E-01	U	0.00E+00 ± 7.00E-02	U	0.00E+00 ± 2.50E-01	U
Ruthenium - 106	0.00E+00 ± 1.89E+00	U	0.00E+00 ± 3.81E+00	U	0.00E+00 ± 4.07E+00	U	0.00E+00 ± 2.78E+00	U	0.00E+00 ± 3.05E+00	U
Silver - 108m	0.00E+00 ± 1.00E-01	U	0.00E+00 ± 2.50E-01	U	0.00E+00 ± 3.00E-01	U	0.00E+00 ± 2.30E-01	U	0.00E+00 ± 2.90E-01	U
Silver - 110m	0.00E+00 ± 1.90E-01	U	0.00E+00 ± 4.00E-01	U	0.00E+00 ± 3.80E-01	U	0.00E+00 ± 2.60E-01	U	0.00E+00 ± 2.40E-01	U
Sodium - 22	0.00E+00 ± 9.00E-02	U	0.00E+00 ± 4.20E-01	U	0.00E+00 ± 3.90E-01	U	0.00E+00 ± 1.50E-01	U	0.00E+00 ± 6.00E-02	U
Thallium - 208	0.00E+00 ± 2.70E-01	U	0.00E+00 ± 5.50E-01	U	0.00E+00 ± 5.20E-01	U	0.00E+00 ± 3.90E-01	U	0.00E+00 ± 3.70E-01	U
Thorium - 227	0.00E+00 ± 1.64E+00	U	0.00E+00 ± 2.94E+00	U	0.00E+00 ± 3.27E+00	U	0.00E+00 ± 2.26E+00	U	0.00E+00 ± 2.47E+00	U
Thorium - 234	0.00E+00 ± 4.18E+00	U	0.00E+00 ± 8.13E+00	U	0.00E+00 ± 7.72E+00	U	0.00E+00 ± 5.75E+00	U	0.00E+00 ± 6.73E+00	U
Zinc - 65	0.00E+00 ± 3.70E-01	U	0.00E+00 ± 3.10E-01	U	0.00E+00 ± 3.90E-01	U	0.00E+00 ± 3.20E-01	U	0.00E+00 ± 3.90E-01	U
Zirconium - 95	0.00E+00 ± 3.40E-01	U	0.00E+00 ± 8.20E-01	U	0.00E+00 ± 6.70E-01	U	0.00E+00 ± 4.90E-01	U	0.00E+00 ± 5.80E-01	U

a. The DQF column contains any data qualifier flags.

ECOLOGICAL STUDY AREA - BIOTIC SAMPLES - ANALYSIS RESULTS FOR RADIONUCLIDE DATA (Continued)

AREA	REF STUDY AREA		REF STUDY AREA		EF STUDY AREA		REF. STUDY AREA		STUDY AREA	
LOCATION	RSA - #3		RSA - #4		RSA - #5		RSA - #5		RSA - #1	
TYPE OF LOCATION	VEG. TYPE 1		VEG. TYPE 1		VEG. TYPE 1		VEG. TYPE 1		VEG. TYPE 2	
SAMPLE NUMBER	ESA23301FR		ESA23401FR		ESA23501FR		ESA23502FR		ESA23601FR	
MEDIA	PLANT BIOTA	D	PLANT BIOTA	D	PLANT BIOTA	D	PLANT BIOTA	D	PLANT BIOTA	D
UNITS	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q
SDG NUMBER	ESA20101FR	F	ESA20101FR	F	ESA20101FR	F	ESA20101FR	F	ESA20601FR	F
FIELD MEASUREMENT Depth (ft)	N/A		N/A		N		N/A		N/A	
Gross Alpha	1.90E-01 ± 1.90E-01	U	2.10E-01 ± 1.90E-01	U	3.60E-01 ± 50E-01	U	2.60E-01 ± 2.20E-01	U	3.10E-01 ± 2.20E-01	U
Gross Beta	3.23E+00 ± 4.30E-01		3.85E+00 ± 4.30E-01		3.90E+00 ± 50E-01		4.03E+00 ± 4.50E-01		6.29E+00 ± 5.00E-01	
Alpha Emitters										
Americium - 241	0.00E+0(6.30E-01	U	0)0E+00 ± 3 50E-0	U	0.00E+00 ± 4 50E-01	U	0.00E+00 4.90E-01	U	0.00E+00 ± 3)0E-01	U
Plutonium - 238										
Plutonium - 239 240										
Uranium - 234										
Uranium - 235	0)0E 00 ± 2.40E+00	U	0.00E+00 ± 1.85E+00	U	0.00E+00 ± 2.79E+00	U	0.00E+00 ± 2 10E+00	U	0.00E+00 ± 2 07E+00	U
Uranium - 238										
Beta Emitters										
Protactinium - 3	0.00E+00 ± 8.20E-01	U	0 00E 00 ± 4.60E-01	U	0 00E+0(± 6.60E-01	U	0 00E+00 3.90E-01	U	0.00E+00 ± 4 40E 01	U
Strontium - 90										
Gamma Emitters										
Antimony - 125	0.00E+00 ± 9.50E-01	U	0.00E+00 ± 9.70E-01	U	0.00E+00 ± 1.01E+00	U	0.00E+00 ± 1.22E+00	U	0.00E+00 ± 9.40E-01	U
Barium - 133	0.00E+00 ± 6.00E-01	U	0.00E+00 ± 4.10E-01	U	0.00E+00 ± 4.80E-01	U	0.00E+00 ± 5.80E-01	U	0.00E+00 ± 5.60E-01	U
Bismuth - 211	0.00E+00 ± 3.56E+00	U	0.00E+00 ± 2.20E+00	U	0.00E+00 ± 2.60E+00	U	0.00E+00 ± 3.39E+00	U	0.00E+00 ± 3.06E+00	U
Bismuth - 214	0.00E+00 ± 1.36E+00	U	0.00E+00 ± 1.02E+00	U	0.00E+00 ± 1.20E+00	U	0.00E+00 ± 1.37E+00	U	0.00E+00 ± 1.25E+00	U
Cadmium - 109	0.00E+00 ± 9.23E+00	U	0.00E+00 ± 7.27E+00	U	0.00E+00 ± 8.62E+00	U	0.00E+00 ± 9.70E+00	U	0.00E+00 ± 7.83E+00	U
Cerium - 144	0.00E+00 ± 1.30E+00	U	0.00E+00 ± 1.73E+00	U	0.00E+00 ± 2.14E+00	U	0.00E+00 ± 2.43E+00	U	0.00E+00 ± 2.32E+00	U
Cesium - 134	0.00E+00 ± 2.90E-01	U	0.00E+00 ± 2.40E-01	U	0.00E+00 ± 3.40E-01	U	0.00E+00 ± 4.60E-01	U	0.00E+00 ± 4.00E-01	U
Cesium - 137	0.00E+00 ± 5.60E-01	U	0.00E+00 ± 4.00E-01	U	0.00E+00 ± 4.40E-01	U	0.00E+00 ± 5.20E-01	U	0.00E+00 ± 4.90E-01	U
Cobalt - 57	0.00E+00 ± 1.70E-01	U	0.00E+00 ± 2.10E-01	U	0.00E+00 ± 2.40E-01	U	0.00E+00 ± 2.70E-01	U	0.00E+00 ± 3.30E-01	U
Cobalt - 58	0.00E+00 ± 2.70E-01	U	0.00E+00 ± 7.00E-02	U	0.00E+00 ± 1.10E-01	U	0.00E+00 ± 1.80E-01	U	0.00E+00 ± 9.00E-02	U
Cobalt - 60	0.00E+00 ± 4.70E-01	U	0.00E+00 ± 2.00E-01	U	0.00E+00 ± 5.40E-01	U	0.00E+00 ± 3.20E-01	U	0.00E+00 ± 2.90E-01	U
Europium - 152	0.00E+00 ± 1.65E+00	U	0.00E+00 ± 4.60E-01	U	0.00E+00 ± 1.25E+00	U	0.00E+00 ± 1.45E+00	U	0.00E+00 ± 1.45E+00	U
Europium - 154	0.00E+00 ± 1.62E+00	U	0.00E+00 ± 1.09E+00	U	0.00E+00 ± 1.34E+00	U	0.00E+00 ± 4.40E-01	U	0.00E+00 ± 1.22E+00	U
Europium - 155	0.00E+00 ± 3.76E+00	U	0.00E+00 ± 2.35E+00	U	0.00E+00 ± 3.12E+00	U	0.00E+00 ± 3.68E+00	U	0.00E+00 ± 3.19E+00	U
Lead - 210	0.00E+00 ± 8.35E+00	U	0.00E+00 ± 5.78E+00	U	0.00E+00 ± 6.84E+00	U	0.00E+00 ± 8.19E+00	U	0.00E+00 ± 6.64E+00	U
Lead - 211	0.00E+00 ± 6.63E+00	U	0.00E+00 ± 7.64E+00	U	0.00E+00 ± 9.49E+00	U	0.00E+00 ± 7.50E+00	U	0.00E+00 ± 9.16E+00	U
Lead - 212	0.00E+00 ± 7.80E-01	U	0.00E+00 ± 6.70E-01	U	0.00E+00 ± 8.70E-01	U	0.00E+00 ± 9.90E-01	U	0.00E+00 ± 7.80E-01	U
Lead - 214	0.00E+00 ± 1.22E+00	U	0.00E+00 ± 7.50E-01	U	0.00E+00 ± 9.20E-01	U	0.00E+00 ± 1.16E+00	U	0.00E+00 ± 1.08E+00	U
Manganese - 54	0.00E+00 ± 2.00E-01	U	0.00E+00 ± 2.40E-01	U	0.00E+00 ± 2.40E-01	U	0.00E+00 ± 1.40E-01	U	0.00E+00 ± 3.80E-01	U
Niobium - 95	0.00E+00 ± 4.90E-01	U	0.00E+00 ± 3.50E-01	U	0.00E+00 ± 3.90E-01	U	0.00E+00 ± 4.30E-01	U	0.00E+00 ± 4.20E-01	U
Potassium - 40	0.00E+00 ± 5.46E+00	U	0.00E+00 ± 2.97E+00	U	0.00E+00 ± 4.87E+00	U	0.00E+00 ± 4.99E+00	U	0.00E+00 ± 4.77E+00	U
Radium - 226	0.00E+00 ± 8.77E+00	U	0.00E+00 ± 6.87E+00	U	0.00E+00 ± 9.48E+00	U	0.00E+00 ± 1.22E+01	U	0.00E+00 ± 7.97E+00	U
Ruthenium - 103	0.00E+00 ± 3.40E-01	U	0.00E+00 ± 2.20E-01	U	0.00E+00 ± 2.90E-01	U	0.00E+00 ± 3.20E-01	U	0.00E+00 ± 3.30E-01	U
Ruthenium - 106	0.00E+00 ± 4.94E+00	U	0.00E+00 ± 3.65E+00	U	0.00E+00 ± 4.10E+00	U	0.00E+00 ± 4.80E+00	U	0.00E+00 ± 4.60E+00	U
Silver - 108m	0.00E+00 ± 2.20E-01	U	0.00E+00 ± 3.20E-01	U	0.00E+00 ± 1.10E-01	U	0.00E+00 ± 2.70E-01	U	0.00E+00 ± 3.90E-01	U
Silver - 110m	0.00E+00 ± 5.30E-01	U	0.00E+00 ± 2.60E-01	U	0.00E+00 ± 4.10E-01	U	0.00E+00 ± 5.10E-01	U	0.00E+00 ± 4.90E-01	U
Sodium - 22	0.00E+00 ± 3.70E-01	U	0.00E+00 ± 6.00E-02	U	0.00E+00 ± 2.00E-01	U	0.00E+00 ± 2.30E-01	U	0.00E+00 ± 4.20E-01	U
Thallium - 208	0.00E+00 ± 6.90E-01	U	0.00E+00 ± 4.90E-01	U	0.00E+00 ± 5.30E-01	U	0.00E+00 ± 5.90E-01	U	0.00E+00 ± 5.40E-01	U
Thorium - 227	0.00E+00 ± 3.34E+00	U	0.00E+00 ± 2.84E+00	U	0.00E+00 ± 3.79E+00	U	0.00E+00 ± 4.17E+00	U	0.00E+00 ± 3.52E+00	U
Thorium - 234	0.00E+00 ± 9.98E+00	U	0.00E+00 ± 8.44E+00	U	0.00E+00 ± 9.95E+00	U	0.00E+00 ± 1.12E+01	U	0.00E+00 ± 8.49E+00	U
Zinc - 65	0.00E+00 ± 5.40E-01	U	0.00E+00 ± 1.40E-01	U	0.00E+00 ± 7.60E-01	U	0.00E+00 ± 1.60E-01	U	0.00E+00 ± 1.70E-01	U
Zirconium - 95	0.00E+00 ± 8.80E-01	U	0.00E+00 ± 7.10E-01	U	0.00E+00 ± 7.80E-01	U	0.00E+00 ± 1.00E+00	U	0.00E+00 ± 9.00E-01	U

a. The DQF column contains any data qualifier flags.

ECOLOGICAL STUDY AREA - BIOTIC SAMPLES - ANALYSIS RESULTS FOR RADIONUCLIDE DATA (Continued)

AREA	REF. STUDY AREA RSA - #2		REF. STUDY AREA RSA - #3		REF. STUDY AREA RSA - #4		REF. STUDY AREA RSA - #5		REF. STUDY AREA RSA - #1	
LOCATION	VEG. TYPE 2		VEG. TYPE 2		VEG. TYPE 2		VEG. TYPE 2		INVERTEBRATE 1	
TYPE OF LOCATION	ESA23701FR		ESA23801FR		ESA23901FR		ESA24001FR		ESA25101FR	
SAMPLE NUMBER	PLANT BIOTA	D	PLANT BIOTA	D	PLANT BIOTA	D	PLANT BIOTA	D	ANIMAL BIOTA	D
MEDIA	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q
UNITS	ESA20601FR	F	ESA20601FR	F	ESA20601FR	F	ESA20601FR	F	ESA25101FR	F
SDG NUMBER										
FIELD MEASUREMENT Depth (ft)	N/A		N/A		N/A		N/A		N/A	
Gross Alpha	2.90E-01 ± 2.30E-01	U	2.10E-01 ± 2.10E-01	U	1.70E-01 ± 1.90E-01	U	2.00E-01 ± 2.00E-01	U	6.20E-01 ± 2.50E-01	
Gross Beta	5.89E+00 ± 5.00E-01		6.54E+00 ± 5.40E-01		5.99E+00 ± 5.10E-01		6.50E+00 ± 5.30E-01		3.25E+00 ± 3.30E-01	
Alpha Emitters										
Americium - 241	0.00E+00 ± 4.30E-01	U	0.00E+00 ± 3.40E-01	U	0.00E+00 ± 2.10E-01	U	0.00E+00 ± 4.10E-01	U	1.00E-03 ± 2.00E-03	U
Plutonium - 238									2.00E-04 ± 1.00E-03	U
Plutonium - 239,240									8.00E-04 ± 2.30E-03	U
Uranium - 234									1.90E-02 ± 8.00E-03	U
Uranium - 235	0.10E+00 ± 2.46E+00	U	0.00E+00 ± 2.08E+00	U	0.00E+00 ± 7.90E-01	U	0.00E+00 ± 2.23E+00	U	2.00E-03 ± 3.00E-03	U
Uranium - 238									1.90E-02 ± 8.00E-03	U
Beta Emitters										
Protactinium - 233	0.00E+00 ± 6.00E-01	U	0.00E+00 ± 4.50E-01	U	0.00E+00 ± 4.90E-0	U	0.00E+00 ± 8.30E-01	U	0.10E+00 ± 3.60E-01	U
Strontium - 90							6.00E-02 ± 9.00E-02	U		
Gamma Emitters										
Antimony - 125	0.00E+00 ± 8.30E-01	U	0.00E+00 ± 7.50E-01	U	0.00E+00 ± 6.00E-01	U	0.00E+00 ± 9.60E-01	U	0.00E+00 ± 5.80E-01	U
Barium - 133	0.00E+00 ± 4.10E-01	U	0.00E+00 ± 5.00E-01	U	0.00E+00 ± 4.00E-01	U	0.00E+00 ± 4.80E-01	U	0.00E+00 ± 2.80E-01	U
Bismuth - 211	0.00E+00 ± 2.16E+00	U	0.00E+00 ± 2.75E+00	U	0.00E+00 ± 2.11E+00	U	0.00E+00 ± 2.46E+00	U	0.00E+00 ± 1.56E+00	U
Bismuth - 214	0.00E+00 ± 1.00E+00	U	0.00E+00 ± 9.60E-01	U	0.00E+00 ± 9.10E-01	U	0.00E+00 ± 1.35E+00	U	0.00E+00 ± 7.50E-01	U
Cadmium - 109	0.00E+00 ± 6.22E+00	U	0.00E+00 ± 7.26E+00	U	0.00E+00 ± 7.36E+00	U	0.00E+00 ± 7.74E+00	U	0.00E+00 ± 4.61E+00	U
Cerium - 144	0.00E+00 ± 1.77E+00	U	0.00E+00 ± 1.87E+00	U	0.00E+00 ± 1.36E+00	U	0.00E+00 ± 6.70E-01	U	0.00E+00 ± 1.35E+00	U
Cesium - 134	0.00E+00 ± 3.20E-01	U	0.00E+00 ± 1.90E-01	U	0.00E+00 ± 1.00E-01	U	0.00E+00 ± 4.10E-01	U	0.00E+00 ± 2.00E-01	U
Cesium - 137	0.00E+00 ± 4.10E-01	U	0.00E+00 ± 4.00E-01	U	0.00E+00 ± 3.20E-01	U	0.00E+00 ± 4.00E-01	U	0.00E+00 ± 2.40E-01	U
Cobalt - 57	0.00E+00 ± 2.40E-01	U	0.00E+00 ± 1.70E-01	U	0.00E+00 ± 1.80E-01	U	0.00E+00 ± 1.70E-01	U	0.00E+00 ± 1.10E-01	U
Cobalt - 58	0.00E+00 ± 1.60E-01	U	0.00E+00 ± 3.00E-01	U	0.00E+00 ± 1.80E-01	U	0.00E+00 ± 3.30E-01	U	0.00E+00 ± 8.00E-02	U
Cobalt - 60	0.00E+00 ± 3.90E-01	U	0.00E+00 ± 2.80E-01	U	0.00E+00 ± 4.00E-01	U	0.00E+00 ± 3.80E-01	U	0.00E+00 ± 1.60E-01	U
Europium - 152	0.00E+00 ± 9.60E-01	U	0.00E+00 ± 1.23E+00	U	0.00E+00 ± 6.70E-01	U	0.00E+00 ± 1.61E+00	U	0.00E+00 ± 2.90E-01	U
Europium - 154	0.00E+00 ± 1.02E+00	U	0.00E+00 ± 1.08E+00	U	0.00E+00 ± 1.06E+00	U	0.00E+00 ± 1.17E+00	U	0.00E+00 ± 7.30E-01	U
Europium - 155	0.00E+00 ± 2.53E+00	U	0.00E+00 ± 2.46E+00	U	0.00E+00 ± 2.53E+00	U	0.00E+00 ± 2.70E+00	U	0.00E+00 ± 1.63E+00	U
Lead - 210	0.00E+00 ± 5.93E+00	U	0.00E+00 ± 5.91E+00	U	0.00E+00 ± 5.63E+00	U	0.00E+00 ± 6.91E+00	U	0.00E+00 ± 4.15E+00	U
Lead - 211	0.00E+00 ± 5.48E+00	U	0.00E+00 ± 6.45E+00	U	0.00E+00 ± 5.98E+00	U	0.00E+00 ± 7.64E+00	U	0.00E+00 ± 5.54E+00	U
Lead - 212	0.00E+00 ± 7.30E-01	U	0.00E+00 ± 6.90E-01	U	0.00E+00 ± 6.90E-01	U	0.00E+00 ± 8.50E-01	U	0.00E+00 ± 4.00E-01	U
Lead - 214	0.00E+00 ± 7.30E-01	U	0.00E+00 ± 9.50E-01	U	0.00E+00 ± 8.00E-01	U	0.00E+00 ± 8.60E-01	U	0.00E+00 ± 5.50E-01	U
Manganese - 54	0.00E+00 ± 3.00E-01	U	0.00E+00 ± 3.30E-01	U	0.00E+00 ± 2.30E-01	U	0.00E+00 ± 3.60E-01	U	0.00E+00 ± 1.80E-01	U
Niobium - 95	0.00E+00 ± 3.30E-01	U	0.00E+00 ± 3.70E-01	U	0.00E+00 ± 2.70E-01	U	0.00E+00 ± 3.50E-01	U	0.00E+00 ± 2.20E-01	U
Potassium - 40	0.00E+00 ± 4.48E+00	U	0.00E+00 ± 6.56E+00	U	0.00E+00 ± 3.12E+00	U	0.00E+00 ± 3.87E+00	U	0.00E+00 ± 3.47E+00	U
Radium - 226	0.00E+00 ± 7.87E+00	U	0.00E+00 ± 7.68E+00	U	0.00E+00 ± 3.00E+00	U	0.00E+00 ± 7.57E+00	U	0.00E+00 ± 4.13E+00	U
Ruthenium - 103	0.00E+00 ± 2.40E-01	U	0.00E+00 ± 2.10E-01	U	0.00E+00 ± 1.70E-01	U	0.00E+00 ± 2.30E-01	U	0.00E+00 ± 1.40E-01	U
Ruthenium - 106	0.00E+00 ± 3.48E+00	U	0.00E+00 ± 3.66E+00	U	0.00E+00 ± 3.76E+00	U	0.00E+00 ± 4.86E+00	U	0.00E+00 ± 2.64E+00	U
Silver - 108m	0.00E+00 ± 3.80E-01	U	0.00E+00 ± 4.20E-01	U	0.00E+00 ± 9.00E-02	U	0.00E+00 ± 3.90E-01	U	0.00E+00 ± 2.80E-01	U
Silver - 110m	0.00E+00 ± 4.20E-01	U	0.00E+00 ± 4.00E-01	U	0.00E+00 ± 3.30E-01	U	0.00E+00 ± 3.90E-01	U	0.00E+00 ± 2.10E-01	U
Sodium - 22	0.00E+00 ± 3.10E-01	U	0.00E+00 ± 2.30E-01	U	0.00E+00 ± 2.70E-01	U	0.00E+00 ± 2.60E-01	U	0.00E+00 ± 2.10E-01	U
Thallium - 208	0.00E+00 ± 4.40E-01	U	0.00E+00 ± 4.90E-01	U	0.00E+00 ± 4.50E-01	U	0.00E+00 ± 5.80E-01	U	0.00E+00 ± 3.30E-01	U
Thorium - 227	0.00E+00 ± 2.94E+00	U	0.00E+00 ± 2.83E+00	U	0.00E+00 ± 2.87E+00	U	0.00E+00 ± 3.69E+00	U	0.00E+00 ± 4.50E-01	U
Thorium - 234	0.00E+00 ± 6.64E+00	U	0.00E+00 ± 8.09E+00	U	0.00E+00 ± 8.42E+00	U	0.00E+00 ± 8.23E+00	U	0.00E+00 ± 5.13E+00	U
Zinc - 65	0.00E+00 ± 6.40E-01	U	0.00E+00 ± 6.00E-01	U	0.00E+00 ± 5.20E-01	U	0.00E+00 ± 8.50E-01	U	0.00E+00 ± 3.80E-01	U
Zirconium - 95	0.00E+00 ± 7.30E-01	U	0.00E+00 ± 8.90E-01	U	0.00E+00 ± 6.60E-01	U	0.00E+00 ± 7.90E-01	U	0.00E+00 ± 5.50E-01	U

a. The DQF column contains any data qualifier flags.

ECOLOGICAL STUDY AREA - BIOTIC SAMPLES - ANALYSIS RESULTS FOR RADIONUCLIDE DATA (Continued)

AREA	REF. STUDY AREA		REF. STUDY AREA		REF. STUDY AREA		REF. STUDY AREA		REF. STUDY AREA	
LOCATION	RSA - #1		RSA - #2		RSA - #2		RSA - #3		RSA - #3	
TYPE OF LOCATION	INVERTEBRATE 1		INVERTEBRATE 1		INVERTEBRATE 1		INVERTEBRATE 1		INVERTEBRATE 1	
SAMPLE NUMBER	ESA25101FR-RE		ESA25201FR		ESA25201FRRE		ESA25301FR		ESA25301FR-RE	
MEDIA	ANIMAL BIOTA	D	ANIMAL BIOTA	D	ANIMAL BIOTA	D	ANIMAL BIOTA	D	ANIMAL BIOTA	D
UNITS	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q
SDG NUMBER	ESA25101FR	F	ESA25101FR	F	ESA25101FR	F	ESA25101FR	F	ESA25101FR	F
FIELD MEASUREMENT										
Depth (ft)	N/A		N/A		N/A		N/A		N/A	
Gross Alpha	3.90E-01 ± 1.90E-01		4.90E-01 ± 2.40E-01		7.50E-01 ± 2.50E-01		7.70E-01 ± 2.80E-01		5.80E-01 ± 2.20E-01	
Gross Beta	3.40E+00 ± 3.10E-01		3.30E+00 ± 3.30E-01		3.42E+00 ± 3.32E-01		3.66E+00 ± 3.40E-01		3.16E+00 ± 3.00E-01	
Alpha Emitters										
Americium - 241			1.00E-03 ± 2.00E-03	U			1.00E-03 ± 2.00E-03	U		
Plutonium - 238			0.00E+00 ± 0.00E+00	U			1.00E-04 ± 1.60E-03	U		
Plutonium - 239,240			1.30E-03 ± 2.90E-03	U			1.40E-03 ± 2.50E-03	U		
Uranium - 234			1.90E-02 ± 6.00E-03				1.30E-02 ± 7.00E-03	U		
Uranium - 235			1.00E-03 ± 2.00E-03	U			1.00E-03 ± 2.00E-03	U		
Uranium - 238			1.60E-02 ± 6.00E-03				1.60E-02 ± 8.00E-03	U		
Beta Emitters										
Protactinium - 233			0.00E+00 ± 3.20E-01	U			0.00E+00 ± 3.70E-01	U		
Strontium - 90										
Gamma Emitters										
Antimony - 125			0.00E+00 ± 6.10E-01	U			0.00E+00 ± 5.60E-01	U		
Barium - 133			0.00E+00 ± 2.60E-01	U			0.00E+00 ± 2.50E-01	U		
Bismuth - 211			0.00E+00 ± 1.50E+00	U			0.00E+00 ± 1.36E+00	U		
Bismuth - 214			0.00E+00 ± 7.00E-01	U			0.00E+00 ± 6.30E-01	U		
Cadmium - 109			0.00E+00 ± 4.38E+00	U			0.00E+00 ± 4.06E+00	U		
Cerium - 144			0.00E+00 ± 1.14E+00	U			0.00E+00 ± 1.06E+00	U		
Cesium - 134			0.00E+00 ± 2.30E-01	U			0.00E+00 ± 1.50E-01	U		
Cesium - 137			0.00E+00 ± 2.30E-01	U			0.00E+00 ± 2.10E-01	U		
Cobalt - 57			0.00E+00 ± 1.30E-01	U			0.00E+00 ± 1.30E-01	U		
Cobalt - 58			0.00E+00 ± 2.20E-01	U			0.00E+00 ± 1.20E-01	U		
Cobalt - 60			0.00E+00 ± 2.10E-01	U			0.00E+00 ± 1.50E-01	U		
Europium - 152			0.00E+00 ± 2.20E-01	U			0.00E+00 ± 8.40E-01	U		
Europium - 154			0.00E+00 ± 7.50E-01	U			0.00E+00 ± 7.20E-01	U		
Europium - 155			0.00E+00 ± 1.64E+00	U			0.00E+00 ± 1.71E+00	U		
Lead - 210			0.00E+00 ± 4.08E+00	U			0.00E+00 ± 3.71E+00	U		
Lead - 211			0.00E+00 ± 3.53E+00	U			0.00E+00 ± 3.61E+00	U		
Lead - 212			0.00E+00 ± 4.10E-01	U			0.00E+00 ± 4.30E-01	U		
Lead - 214			0.00E+00 ± 4.70E-01	U			0.00E+00 ± 4.60E-01	U		
Manganese - 54			0.00E+00 ± 1.50E-01	U			0.00E+00 ± 1.00E-01	U		
Niobium - 95			0.00E+00 ± 1.90E-01	U			0.00E+00 ± 2.50E-01	U		
Potassium - 40			0.00E+00 ± 2.73E+00	U			0.00E+00 ± 2.33E+00	U		
Radium - 226			0.00E+00 ± 4.51E+00	U			0.00E+00 ± 4.07E+00	U		
Ruthenium - 103			0.00E+00 ± 1.00E-01	U			0.00E+00 ± 1.90E-01	U		
Ruthenium - 106			0.00E+00 ± 2.59E+00	U			0.00E+00 ± 2.21E+00	U		
Silver - 108m			0.00E+00 ± 6.00E-02	U			0.00E+00 ± 2.00E-01	U		
Silver - 110m			0.00E+00 ± 2.20E-01	U			0.00E+00 ± 1.70E-01	U		
Sodium - 22			0.00E+00 ± 5.00E-02	U			0.00E+00 ± 9.00E-02	U		
Thallium - 208			0.00E+00 ± 3.00E-01	U			0.00E+00 ± 3.20E-01	U		
Thorium - 227			0.00E+00 ± 1.87E+00	U			0.00E+00 ± 1.93E+00	U		
Thorium - 234			0.00E+00 ± 5.03E+00	U			0.00E+00 ± 4.32E+00	U		
Zinc - 65			0.00E+00 ± 3.50E-01	U			0.00E+00 ± 9.00E-02	U		
Zirconium - 95			0.00E+00 ± 4.10E-01	U			0.00E+00 ± 4.30E-01	U		

a. The DQF column contains any data qualifier flags.

ECOLOGICAL STUDY AREA - BIOTIC SAMPLES - ANALYSIS RESULTS FOR RADIONUCLIDE DATA (Continued)

AREA	REF. STUDY AREA		REF. STUDY AREA		REF. STUDY AREA		REF. STUDY AREA		REF. STUDY AREA	
LOCATION	RSA - #4		RSA - #4		RSA - #5		RSA - #5		RSA - #1	
TYPE OF LOCATION	INVERTEBRATE 1		INVERTEBRATE 1		INVERTEBRATE 1		INVERTEBRATE 1		INVERTEBRATE 2	
SAMPLE NUMBER	ESA25401FR		ESA25401FR-RE		ESA25502FR		ESA25502FR-RE		ESA25601FR	
MEDIA	ANIMAL BIOTA	D	ANIMAL BIOTA	D	ANIMAL BIOTA	D	ANIMAL BIOTA	D	ANIMAL BIOTA	D
UNITS	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q
SDG NUMBER	ESA25101FR	F	ESA25101FR	F	ESA25101FR	F	ESA25101FR	F	ESA22601FR	F
FIELD MEASUREMENT										
Depth (ft)	N/A		N/A		N/A		N/A		N/A	
Gross Alpha	8.50E-01 ± 2.90E-01		0.57E-00 ± 0.22E-00		1.21E+00 ± 3.40E-01		6.30E-01 ± 2.20E-01		2.80E-01 ± 1.70E-01	U
Gross Beta	3.67E+00 ± 3.50E-01		3.28E-00 ± 0.31E-00		3.58E+00 ± 3.40E-01		3.26E+00 ± 3.00E-01		2.90E+00 ± 2.90E-01	
Alpha Emitters										
Americium - 241	2.00E-03 ± 2.00E-03	U			1.00E-03 ± 2.00E-03	U			0.00E+00 3.80E-01	U
Plutonium - 238	0.00E+00 ± 0.00E+00	U			2.00E-04 ± 1.30E-03	U				
Plutonium - 239,240	1.30E-03 ± 2.40E-03	U			1.40E-03 ± 3.10E-03	U				
Uranium - 234	1.80E-02 ± 8.00E-03				1.80E-02 ± 8.00E-03					
Uranium - 235	1.00E-03 ± 2.00E-03	U			1.00E-03 ± 2.00E-03	U			0.00E+00 ± 1.86E+00	U
Uranium - 238	1.50E-02 ± 7.00E-03				2.10E-02 ± 8.00E-03					
Beta Emitters										
Protactinium - 233	0.00E+00 ± 2.10E-01	U			0.00E+00 ± 2.60E-01	U			0.00E+00 ± 5.10E-01	U
Strontium - 90					1.70E-01 ± 7.00E-02					
Gamma Emitters										
Antimony - 125	0.00E+00 ± 5.40E-01	U			0.00E+00 ± 3.90E-01	U			0.00E+00 ± 7.60E-01	U
Barium - 133	0.00E+00 ± 2.40E-01	U			0.00E+00 ± 3.10E-01	U			0.00E+00 ± 3.80E-01	U
Bismuth - 211	0.00E+00 ± 1.26E+00	U			0.00E+00 ± 1.62E+00	U			0.00E+00 ± 1.75E+00	U
Bismuth - 214	0.00E+00 ± 6.40E-01	U			0.00E+00 ± 6.20E-01	U			0.00E+00 ± 1.11E+00	U
Cadmium - 109	0.00E+00 ± 3.66E+00	U			0.00E+00 ± 4.18E+00	U			0.00E+00 ± 6.12E+00	U
Cerium - 144	0.00E+00 ± 9.00E-01	U			0.00E+00 ± 1.18E+00	U			0.00E+00 ± 1.05E+00	U
Cesium - 134	0.00E+00 ± 9.00E-02	U			0.00E+00 ± 9.00E-02	U			0.00E+00 ± 1.60E-01	U
Cesium - 137	0.00E+00 ± 2.00E-01	U			0.00E+00 ± 2.30E-01	U			0.00E+00 ± 3.10E-01	U
Cobalt - 57	0.00E+00 ± 1.10E-01	U			0.00E+00 ± 1.20E-01	U			0.00E+00 ± 1.90E-01	U
Cobalt - 58	0.00E+00 ± 9.00E-02	U			0.00E+00 ± 1.30E-01	U			0.00E+00 ± 6.00E-02	U
Cobalt - 60	0.00E+00 ± 1.90E-01	U			0.00E+00 ± 2.60E-01	U			0.00E+00 ± 2.80E-01	U
Europium - 152	0.00E+00 ± 4.70E-01	U			0.00E+00 ± 4.50E-01	U			0.00E+00 ± 1.86E+00	U
Europium - 154	0.00E+00 ± 6.10E-01	U			0.00E+00 ± 6.50E-01	U			0.00E+00 ± 9.90E-01	U
Europium - 155	0.00E+00 ± 7.50E-01	U			0.00E+00 ± 1.74E+00	U			0.00E+00 ± 2.58E+00	U
Lead - 210	0.00E+00 ± 3.38E+00	U			0.00E+00 ± 3.54E+00	U			0.00E+00 ± 6.14E+00	U
Lead - 211	0.00E+00 ± 4.46E+00	U			0.00E+00 ± 4.35E+00	U			0.00E+00 ± 5.25E+00	U
Lead - 212	0.00E+00 ± 4.30E-01	U			0.00E+00 ± 4.50E-01	U			0.00E+00 ± 6.90E-01	U
Lead - 214	0.00E+00 ± 4.20E-01	U			0.00E+00 ± 5.60E-01	U			0.00E+00 ± 7.00E-01	U
Manganese - 54	0.00E+00 ± 9.00E-02	U			0.00E+00 ± 2.10E-01	U			0.00E+00 ± 2.30E-01	U
Niobium - 95	0.00E+00 ± 1.90E-01	U			0.00E+00 ± 2.10E-01	U			0.00E+00 ± 2.60E-01	U
Potassium - 40	0.00E+00 ± 2.35E+00	U			0.00E+00 ± 2.29E+00	U			0.00E+00 ± 7.38E+00	U
Radium - 226	0.00E+00 ± 4.85E+00	U			0.00E+00 ± 5.14E+00	U			0.00E+00 ± 7.51E+00	U
Ruthenium - 103	0.00E+00 ± 1.60E-01	U			0.00E+00 ± 1.50E-01	U			0.00E+00 ± 1.30E-01	U
Ruthenium - 106	0.00E+00 ± 2.31E+00	U			0.00E+00 ± 2.21E+00	U			0.00E+00 ± 2.94E+00	U
Silver - 108m	0.00E+00 ± 5.00E-02	U			0.00E+00 ± 1.70E-01	U			0.00E+00 ± 1.90E-01	U
Silver - 110m	0.00E+00 ± 1.90E-01	U			0.00E+00 ± 1.60E-01	U			0.00E+00 ± 2.40E-01	U
Sodium - 22	0.00E+00 ± 1.10E-01	U			0.00E+00 ± 1.70E-01	U			0.00E+00 ± 3.30E-01	U
Thallium - 208	0.00E+00 ± 2.40E-01	U			0.00E+00 ± 2.60E-01	U			0.00E+00 ± 3.90E-01	U
Thorium - 227	0.00E+00 ± 1.81E+00	U			0.00E+00 ± 7.20E-01	U			0.00E+00 ± 2.84E+00	U
Thorium - 234	0.00E+00 ± 4.04E+00	U			0.00E+00 ± 4.54E+00	U			0.00E+00 ± 6.61E+00	U
Zinc - 65	0.00E+00 ± 2.00E-01	U			0.00E+00 ± 4.00E-01	U			0.00E+00 ± 4.40E-01	U
Zirconium - 95	0.00E+00 ± 3.40E-01	U			0.00E+00 ± 4.80E-01	U			0.00E+00 ± 7.40E-01	U

a. The DQF column contains any data qualifier flags.

ECOLOGICAL STUDY AREA - BIOTIC SAMPLES - ANALYSIS RESULTS FOR RADIONUCLIDE DATA (Continued)

AREA	REF. STUDY AREA		REF. STUDY AREA		REF. STUDY AREA		REF. STUDY AREA		REF. STUDY AREA	
LOCATION	RSA - #2		RSA - #3		RSA - #4		RSA - #4		RSA - #5	
TYPE OF LOCATION	INVERTEBRATE 2		INVERTEBRATE 2		INVERTEBRATE 2		INVERTEBRATE 2		INVERTEBRATE 2	
SAMPLE NUMBER	ESA25701FR		ESA25801FR		ESA25901FR		ESA25901FR-RE		ESA26002FR	
MEDIA	ANIMAL BIOTA	D	ANIMAL BIOTA	D	ANIMAL BIOTA	D	ANIMAL BIOTA	D	ANIMAL BIOTA	D
UNITS	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q	pCi/g	Q
SDG NUMBER	ESA22601FR	F	ESA22601FR	F	ESA22601FR	F	ESA22601FR	F	ESA22601FR	F
FIELD MEASUREMENT Depth (ft)	N/A		N/A		N/A		N/A		N/A	
Gross Alpha	4.40E-01 ± 2.30E-01	U	2.80E-01 ± 1.70E-01	U	4.40E-01 ± 2.00E-01	J	2.10E-01 ± 1.40E-01	U	2.20E-01 ± 1.60E-01	U
Gross Beta	2.95E+00 ± 3.00E-01		3.32E+00 ± 3.20E-01		3.38E+00 ± 3.20E-01		3.17E+00 ± 2.90E-01		3.29E+00 ± 3.10E-01	
Alpha Emitters										
Americium - 241	0.00E+00 ± 4.10E-01	U	0.00E+00 ± 3.40E-01	U	0.00E+00 ± 3.00E-01	U			0.00E+00 ± 3.20E-01	U
Plutonium - 238										
Plutonium - 239,240										
Uranium - 234										
Uranium - 235	0.00E+00 ± 1.76E+00	U	0.00E+00 ± 1.24E+00	U	0.00E+00 ± 1.71E+00	U			0.00E+00 ± 1.60E+00	U
Uranium - 238										
Beta Emitters										
Protactinium - 233	0.00E+00 ± 5.10E-01	U	0.00E+00 ± 2.20E-01	U	0.00E+00 ± 5.00E-01	U			0.00E+00 ± 4.40E-01	U
Strontium - 90					1.10E-01 ± 6.00E-02	U				
Gamma Emitters										
Antimony - 125	0.00E+00 ± 9.10E-01	U	0.00E+00 ± 5.80E-01	U	0.00E+00 ± 4.60E-01	U			0.00E+00 ± 4.90E-01	U
Barium - 133	0.00E+00 ± 3.80E-01	U	0.00E+00 ± 3.70E-01	U	0.00E+00 ± 3.60E-01	U			0.00E+00 ± 3.40E-01	U
Bismuth - 211	0.00E+00 ± 2.19E+00	U	0.00E+00 ± 2.09E+00	U	0.00E+00 ± 2.10E+00	U			0.00E+00 ± 1.96E+00	U
Bismuth - 214	0.00E+00 ± 1.14E+00	U	0.00E+00 ± 9.10E-01	U	0.00E+00 ± 1.11E+00	U			0.00E+00 ± 1.00E+00	U
Cadmium - 109	0.00E+00 ± 6.36E+00	U	0.00E+00 ± 5.52E+00	U	0.00E+00 ± 6.06E+00	U			0.00E+00 ± 5.86E+00	U
Cerium - 144	0.00E+00 ± 1.54E+00	U	0.00E+00 ± 1.50E+00	U	0.00E+00 ± 1.50E+00	U			0.00E+00 ± 1.80E+00	U
Cesium - 134	0.00E+00 ± 3.00E-01	U	0.00E+00 ± 2.20E-01	U	0.00E+00 ± 1.80E-01	U			0.00E+00 ± 2.90E-01	U
Cesium - 137	0.00E+00 ± 3.10E-01	U	0.00E+00 ± 2.70E-01	U	0.00E+00 ± 3.10E-01	U			0.00E+00 ± 3.20E-01	U
Cobalt - 57	0.00E+00 ± 1.90E-01	U	0.00E+00 ± 1.30E-01	U	0.00E+00 ± 1.90E-01	U			0.00E+00 ± 1.20E-01	U
Cobalt - 58	0.00E+00 ± 2.60E-01	U	0.00E+00 ± 1.60E-01	U	0.00E+00 ± 2.10E-01	U			0.00E+00 ± 8.00E-02	U
Cobalt - 60	0.00E+00 ± 2.60E-01	U	0.00E+00 ± 2.60E-01	U	0.00E+00 ± 3.40E-01	U			0.00E+00 ± 3.00E-01	U
Europium - 152	0.00E+00 ± 2.55E+00	U	0.00E+00 ± 2.16E+00	U	0.00E+00 ± 1.93E+00	U			0.00E+00 ± 5.40E-01	U
Europium - 154	0.00E+00 ± 1.01E+00	U	0.00E+00 ± 8.60E-01	U	0.00E+00 ± 1.01E+00	U			0.00E+00 ± 9.60E-01	U
Europium - 155	0.00E+00 ± 2.56E+00	U	0.00E+00 ± 1.99E+00	U	0.00E+00 ± 2.35E+00	U			0.00E+00 ± 2.42E+00	U
Lead - 210	0.00E+00 ± 6.65E+00	U	0.00E+00 ± 5.49E+00	U	0.00E+00 ± 6.54E+00	U			0.00E+00 ± 4.91E+00	U
Lead - 211	0.00E+00 ± 6.94E+00	U	0.00E+00 ± 6.73E+00	U	0.00E+00 ± 4.43E+00	U			0.00E+00 ± 5.61E+00	U
Lead - 212	0.00E+00 ± 6.60E-01	U	0.00E+00 ± 6.40E-01	U	0.00E+00 ± 6.50E-01	U			0.00E+00 ± 6.40E-01	U
Lead - 214	0.00E+00 ± 7.70E-01	U	0.00E+00 ± 7.50E-01	U	0.00E+00 ± 7.50E-01	U			0.00E+00 ± 6.80E-01	U
Manganese - 54	0.00E+00 ± 2.40E-01	U	0.00E+00 ± 2.80E-01	U	0.00E+00 ± 2.50E-01	U			0.00E+00 ± 2.30E-01	U
Niobium - 95	0.00E+00 ± 2.90E-01	U	0.00E+00 ± 3.20E-01	U	0.00E+00 ± 2.70E-01	U			0.00E+00 ± 3.00E-01	U
Potassium - 40	0.00E+00 ± 7.94E+00	U	0.00E+00 ± 7.14E+00	U	0.00E+00 ± 7.37E+00	U			0.00E+00 ± 3.14E+00	U
Radium - 226	0.00E+00 ± 8.47E+00	U	0.00E+00 ± 6.38E+00	U	0.00E+00 ± 8.19E+00	U			0.00E+00 ± 7.28E+00	U
Ruthenium - 103	0.00E+00 ± 1.90E-01	U	0.00E+00 ± 2.10E-01	U	0.00E+00 ± 1.60E-01	U			0.00E+00 ± 1.80E-01	U
Ruthenium - 106	0.00E+00 ± 3.17E+00	U	0.00E+00 ± 2.59E+00	U	0.00E+00 ± 2.99E+00	U			0.00E+00 ± 3.70E+00	U
Silver - 108m	0.00E+00 ± 7.00E-02	U	0.00E+00 ± 2.20E-01	U	0.00E+00 ± 9.00E-02	U			0.00E+00 ± 9.00E-02	U
Silver - 110m	0.00E+00 ± 2.90E-01	U	0.00E+00 ± 2.70E-01	U	0.00E+00 ± 2.60E-01	U			0.00E+00 ± 2.70E-01	U
Sodium - 22	0.00E+00 ± 9.40E-01	U	0.00E+00 ± 2.90E-01	U	0.00E+00 ± 1.20E-01	U			0.00E+00 ± 2.80E-01	U
Thallium - 208	0.00E+00 ± 3.70E-01	U	0.00E+00 ± 3.80E-01	U	0.00E+00 ± 3.70E-01	U			0.00E+00 ± 4.30E-01	U
Thorium - 227	0.00E+00 ± 2.67E+00	U	0.00E+00 ± 2.75E+00	U	0.00E+00 ± 2.81E+00	U			0.00E+00 ± 2.60E+00	U
Thorium - 234	0.00E+00 ± 7.04E+00	U	0.00E+00 ± 6.00E+00	U	0.00E+00 ± 6.74E+00	U			0.00E+00 ± 6.65E+00	U
Zinc - 65	0.00E+00 ± 1.80E-01	U	0.00E+00 ± 3.20E-01	U	0.00E+00 ± 2.10E-01	U			0.00E+00 ± 4.80E-01	U
Zirconium - 95	0.00E+00 ± 4.50E-01	U	0.00E+00 ± 5.40E-01	U	0.00E+00 ± 6.10E-01	U			0.00E+00 ± 5.50E-01	U

a. The DQF column contains any data qualifier flags.